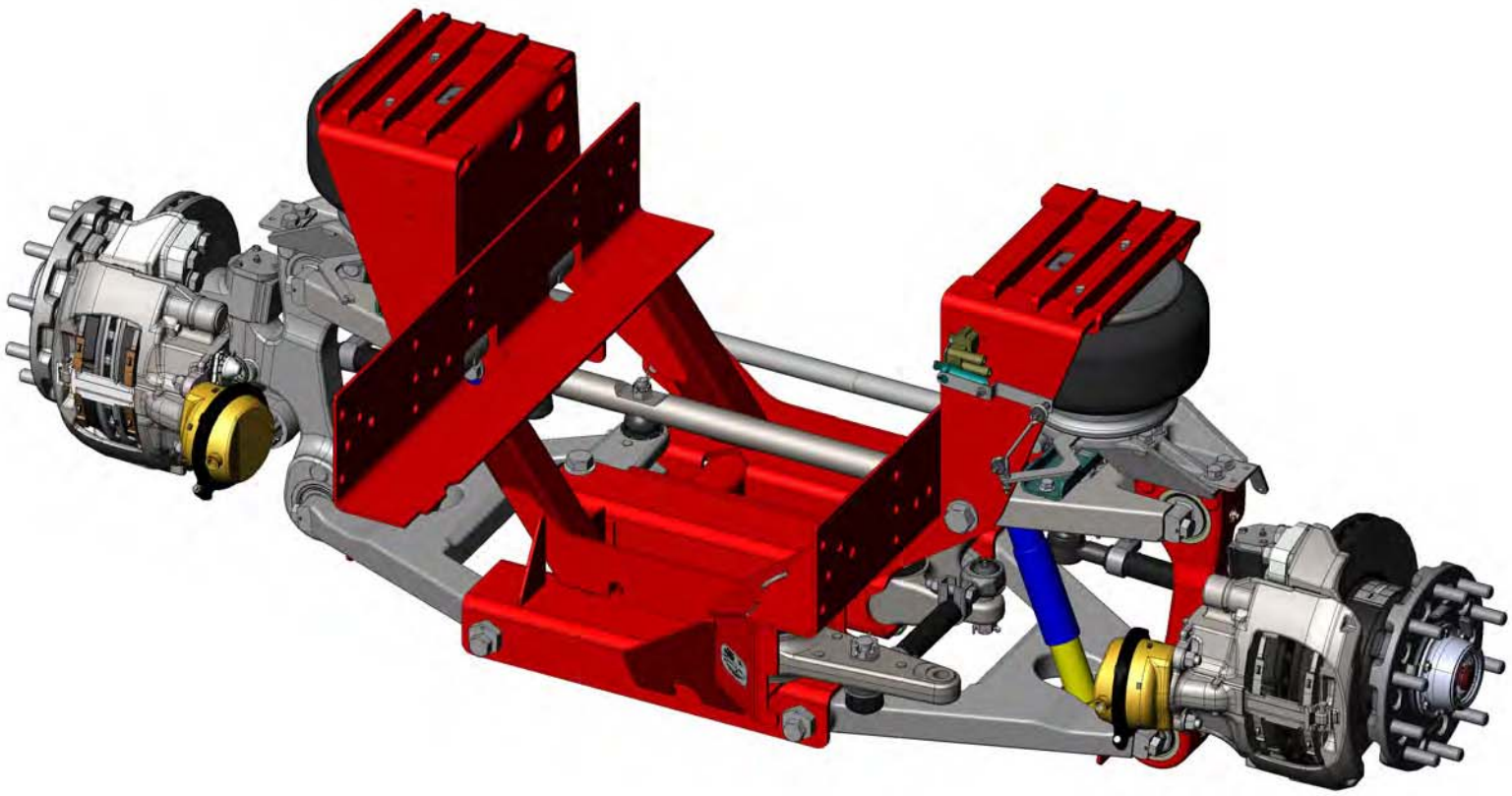
Reyco Granning SUSPENSIONS

Motorhome Suspensions **Owner's Manual**

IFS1700S | Independent Front Suspension

Maintenance Instructions
Service Parts



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COMPANY PROFILE

Reyco Granning Suspensions was formed by the merger and acquisition of two well-known names in the heavy-duty vehicle suspension industry: Reyco and Granning.

Reyco grew out of the Reynolds Mfg. Co. and was first known as a major supplier of brake drums for heavy-duty vehicles, and later developed a full line of air and steel spring suspensions for trucks, busses, trailers, and motorhomes.

Granning Air Suspensions was founded in 1949 in Detroit, Michigan as a manufacturer of auxiliary lift axle suspensions. Granning later became an innovator of independent front air suspensions for the motorhome industry.

Reyco Granning LLC was formed in early 2011 through a partnering of senior managers and MAT Capital, a private investment group headquartered in Long Grove, Illinois.

Reyco Granning manufacturing facilities are certified to the ISO9001:2008 standards, a globally recognized assurance that quality standards have been established and are maintained by regular rigorous audits.

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Introduction

Service Notes

This Service Manual describes the correct service and repair procedures for the ***Reyco*Granning**® IFS1700S Independent Front Suspension model with 17,000 lbs Gross Axle Weight Rating (GAWR). Overloading the suspension may result in adverse ride and handling characteristics.

You must read and understand all procedures and safety precautions presented in this manual before conducting any service work on the suspension.

Proper tools must be used to perform the maintenance and repair procedures in this manual. Some procedures require the use of special tools for safe and correct service. Failure to use the proper and/or special tools when required can cause personal injury and/or damage to suspension components.

You must follow your company safety procedures and use proper safety equipment when you service or repair the suspension.

The information contained in this manual was current at the time of printing and is subject to change without notice or liability. ***Reyco*Granning**® reserves the right to modify the suspension and/or procedures and to change specifications at any time without notice and without incurring obligation.

***Reyco*Granning**® uses the following types of notices for potential safety problems and to give information that will prevent damage to equipment.

⚠ WARNING

A warning indicates procedures that must be followed exactly. Serious personal injury can occur if the procedure is not followed.

⚠ CAUTION

A caution indicates procedures that must be followed exactly. Damage to equipment or suspension components and personal injury can occur if the procedure is not followed.

NOTE

A note indicates an operation, procedure or instruction that is important for correct service.

Identification

The suspension model and serial number are stamped on an aluminum tag that is riveted to the front of the suspension sub-frame assembly (**Figure 1**). The serial number is used by ***ReycoGranning***® for control purposes and should be referred to when servicing the suspension or requesting technical support (**Figure 2**).

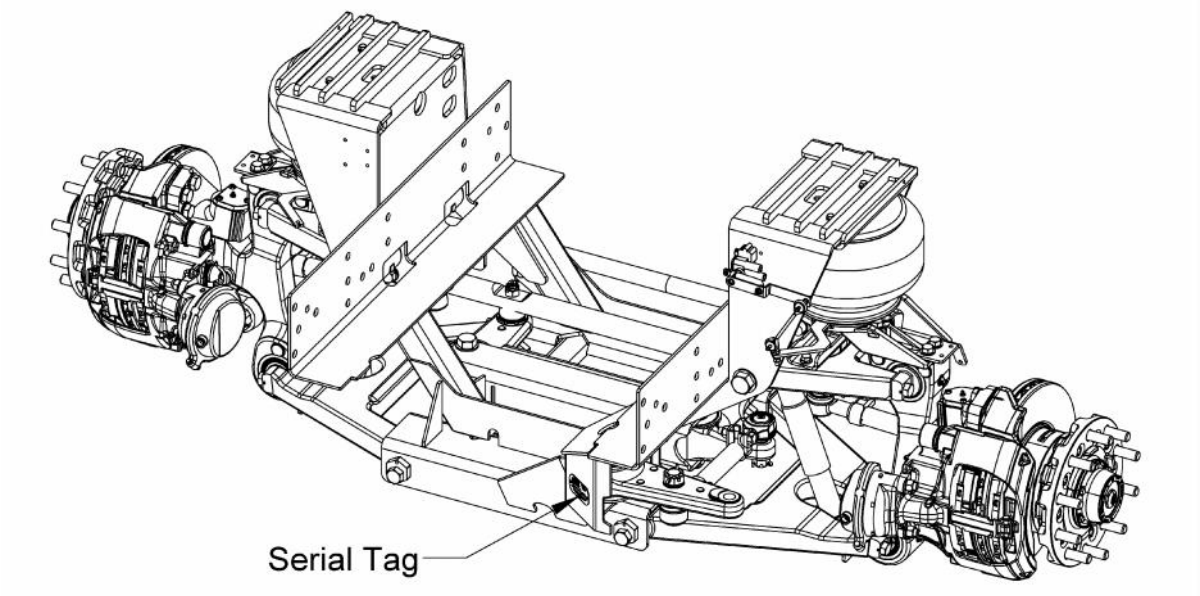


Figure 1 - Suspension Identification Location

Figure 2 - Suspension Serial Number Tag

Model	GAWR (lb)	Wheel Cut	Disc Brakes	Sway Bar	Height Control	
IFS1700S	17,000	55°	Bendix ADB22X	No	Valve	Dual
IFS1700S-SB				Yes		Single
IFS1700S-SHC				No	Electronic Sensor	Dual
IFS1700S-SHCSB				Yes		Single

Table 1 - Model Identification

Vehicle Towing Information

If a vehicle is disabled and needs to be towed by the front end to service center, check the OEM/Coach Builder towing procedures for the recommended method. Check with local authorities and Department of Transportation (DOT) for permissible towing methods before towing. Some states do not permit towing by chains and/or straps.

The preferred towing apparatus is the type that cradles the front tires. If the towing apparatus cannot be attached to the front tires or directly to the chassis frame rails, then the suspension sub-frame may be used for attachment.

⚠ WARNING

Attaching towing equipment to improper locations and failure to utilize OEM/Coach Builder recommended towing methods could result in one or more of the following:

- **Loss of vehicle control.**
- **Possible disconnection from tow vehicle.**
- **Damage to the suspension and/or vehicle.**

Do Not attach tow apparatus (hooks, chains, straps, etc.) to suspension upper and lower control arms, sway bar and brackets, brake components, tie rods, steering arm assemblies, or steering knuckle carrier assemblies (**Figure 3**).

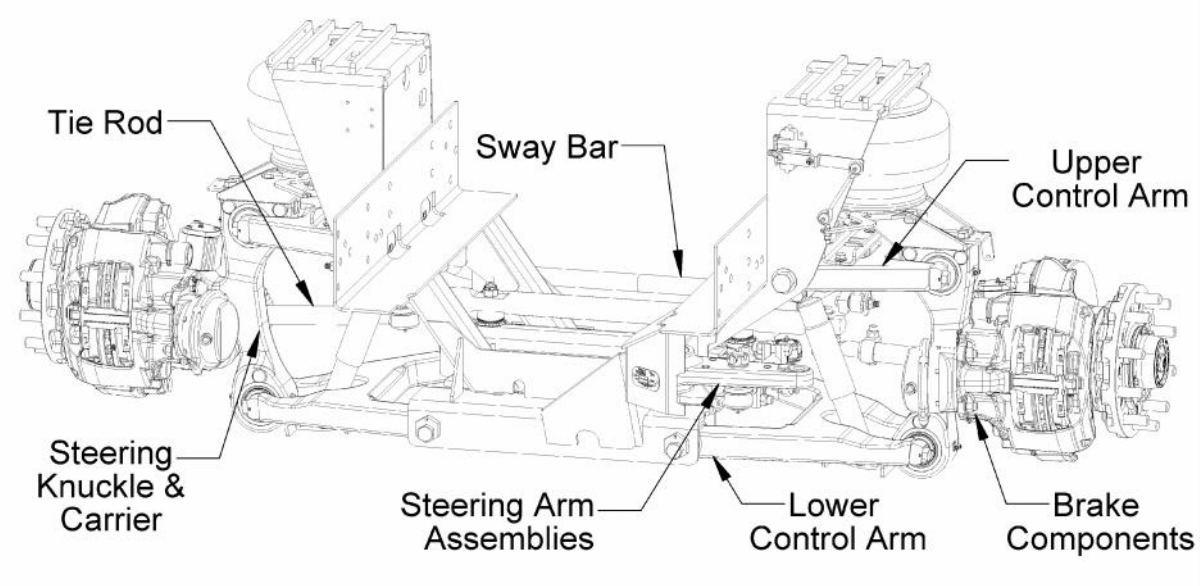


Figure 3 – <u>Improper</u> Tow Equipment Attachment Locations

Maintenance Schedule

GENERAL MAINTENANCE	SERVICE TO BE PERFORMED	MILEAGE IN THOUSANDS							
		12	24	36	48	60	72	84	96
Steering Arm Assembly Ball Joints	Check axial endplay				X				X[2]
	Inspect for ruptured seals	X	X	X	X	X	X	X	X[2]
	Check that cotter pin is installed	X	X	X	X	X	X	X	X[2]
Control Arm Bushings	Check bolt torque				X				X[2]
	Inspect for control arm and mount contact	X	X	X	X	X	X	X	X[2]
	Inspect for bushing wear	X	X	X	X	X	X	X	X[2]
Tie Rod Ends	Inspect ball socket endplay	X	X	X	X	X	X	X	X[2]
	Check for taper connection looseness	X	X	X	X	X	X	X	X[2]
	Check cotter pin installation	X	X	X	X	X	X	X	X[2]
Brake System	Inspect Brake Pads for excessive or uneven wear	X		X		X		X[2]	
	Inspect Brake Caliper for minimum free play	X		X		X		X[2]	
	Inspect for Air Leaks using soapy water solution	X							
Air Springs	Inspect for proper clearance (1” minimum all around)	X							
	Check upper mount nut and lower mount bolt torque	X							
	Inspect for signs of chafing or wear	X	X	X	X	X	X	X	X[2]
	Inspect for air leaks using soapy water solution	X							
Height Control Valve and Linkage	Inspect for signs of bending, binding, or slippage	X	X	X	X	X	X	X	X[2]
	Inspect for air leaks using soapy water solution	X							
Shock Absorbers	Check mounting nut torque	X							
	Inspect shocks for signs of fluid leak, broken eye ends, loose fasteners, or worn bushings	X	X	X	X	X	X	X	X[2]
Kingpins	Check for wear				X				X[2]
	Inspect vertical endplay				X				X[2]
Steering Arm Assembly Bearings	Check Mounting Nut torque				X				X[2]
	Inspect bearings for excessive radial play	X	X	X	X	X	X	X	X[2]
Carrier Bearings	Check axial endplay								X[2]
Wheels	Check Wheel Bearing endplay				X				X[2]
	Check Wheel Nut torque[1]	X	X	X	X	X	X	X	X[2]
Front Alignment	Inspect toe-in[3]		X		X		X		X[2]
Air Fittings and Air Lines	Inspect for air leaks using soapy water solution	X							
	Inspect for signs of chafing, cracking, or wear	X	X	X	X	X	X	X	X[2]
Sway Bar Bushings	Check mounting bolt torque				X				X[2]
	Inspect for bushing wear	X	X	X	X	X	X	X	X[2]

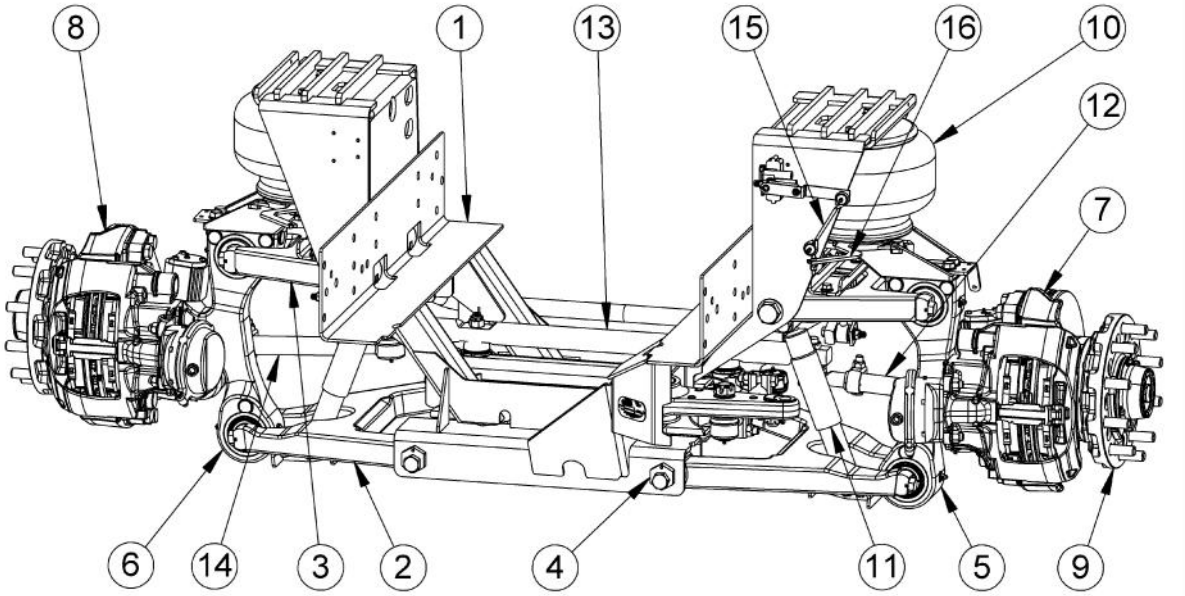
1. Wheel Nuts must be re-tightened to proper torque specifications as per the vehicle or chassis manufacturer’s Owner Guide
2. Continue to perform specified maintenance every 12,000 miles or at previous interval
3. Final stage manufacturer should complete toe-in inspection and adjustment after completion of vehicle

Maintenance Record

Name of Owner:			Address of Owner:
Date of Purchase:	Name and Address of Dealer:		
Model of Vehicle:	Vehicle Identification Number:		
Suspension Model Number: **IFS1700S; IFS1700S-SB; IFS1700S-SHC; IFS1700S-SHCSB**	Suspension Serial Number:		
Inspection and Maintenance Item	Date	Mileage	Service Performed

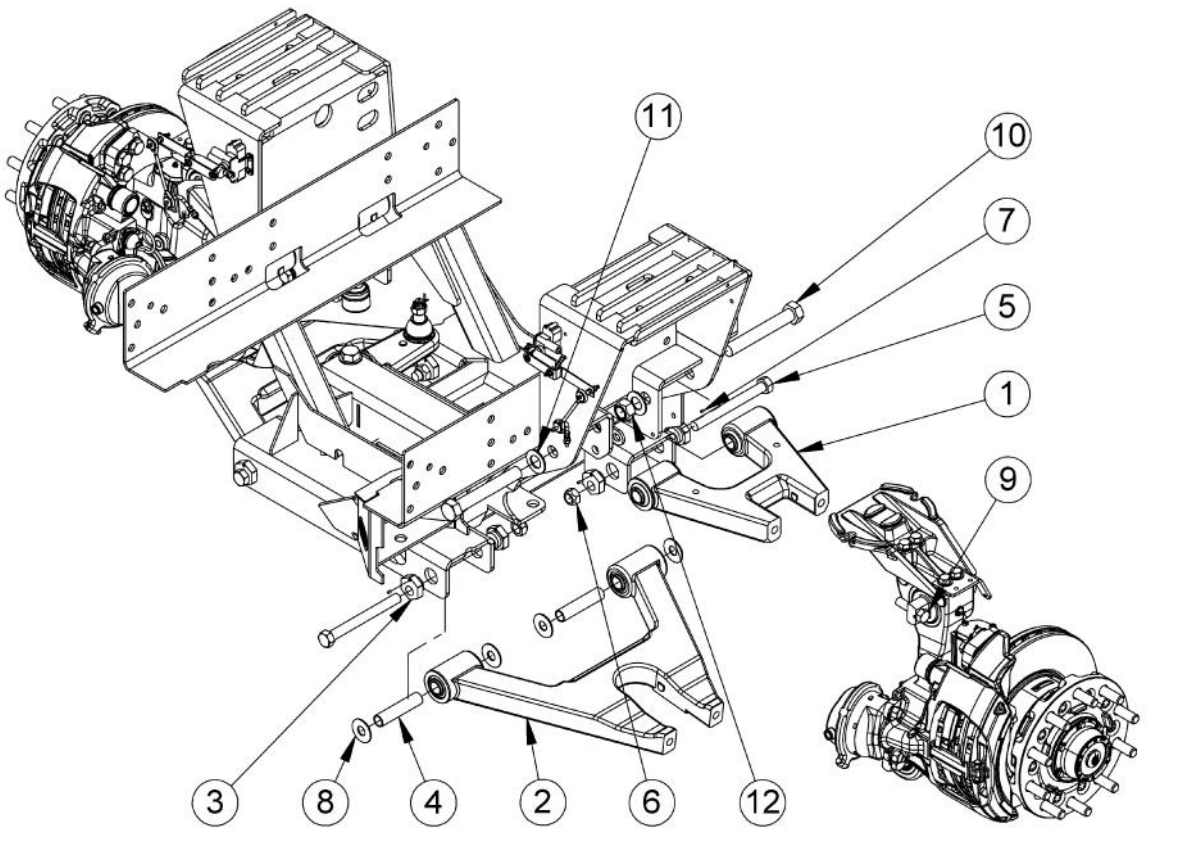
Unit Assembly

Item	Part No.	Description	Item	Part No.	Description
1	711511-01	Sub frame Assembly	9	707819-01	Hub and Rotor Assembly
2	700944-01	Lower Control Arm Assembly	10	705951-01	Air Spring Assembly
3	703182-01	Upper Control Arm Assembly	11	700178-06	Shock Absorber
4	700245-01	Boss, Eccentric	12	700973-01	Tie Rod Assembly, LH
5	705633-01	Carrier Assembly, LH	13	702030-01	Relay Rod
6	705633-02	Carrier Assembly, RH	14	700973-02	Tie Rod Assembly, RH
7	705013-17	Caliper Assembly, LH	15	703915-01	Height Control Linkage Assembly
8	705013-18	Caliper Assembly, RH	16	706899-01	Height Control Arm



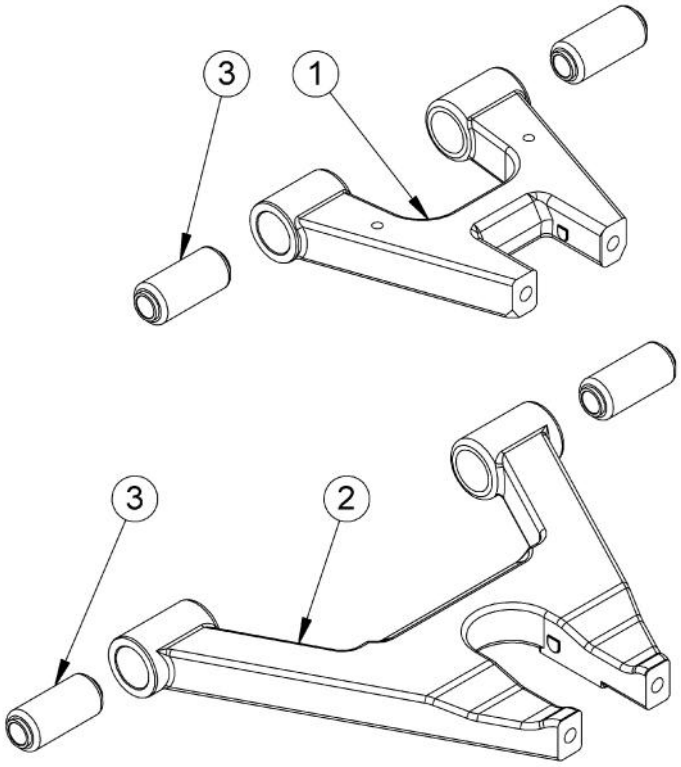
Control Arm Components

Item	Part No.	Description	Item	Part No.	Description
1	703182-01	Assembly, Upper Control Arm	7	293	Socket Set Screw 10-24 x .38”
2	700944-01	Assembly, Lower Control Arm	8	701683-04	Hardened Flat Washer, 7/8”
3	700245-01	Boss, Eccentric	9	100039-P1	Hex Head Bolt 3/4-10 x 2.75, Gr. 8, Zn
4	8490	Spacer	10	702516-02	Hex Head Bolt 1 1/8-12 x 7.75, Gr. 8, ZY
5	292	Hex Head Bolt 7/8-9 x 8.50, Gr. 8, ZN	11	168	Hardened Flat Washer, 1 1/8”
6	100122-P1	Lock Nut 7/8-9”, Gr. C	12	166	Lock Nut 1 1/8-12, Gr. C



Control Arm Assemblies

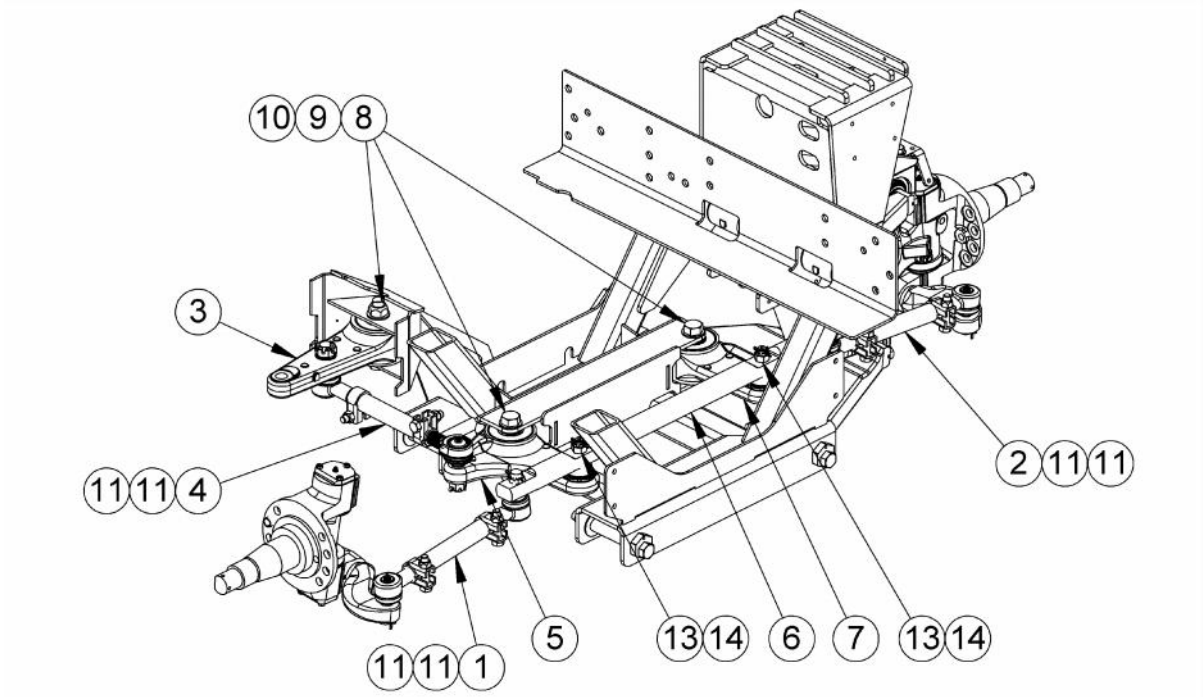
Item	Part No.	Description	Item	Part No.	Description
1	703181-01	Upper Control Arm, LH & RH	3	8382	Bushing
2	700939-01	Lower Control Arm, LH & RH			

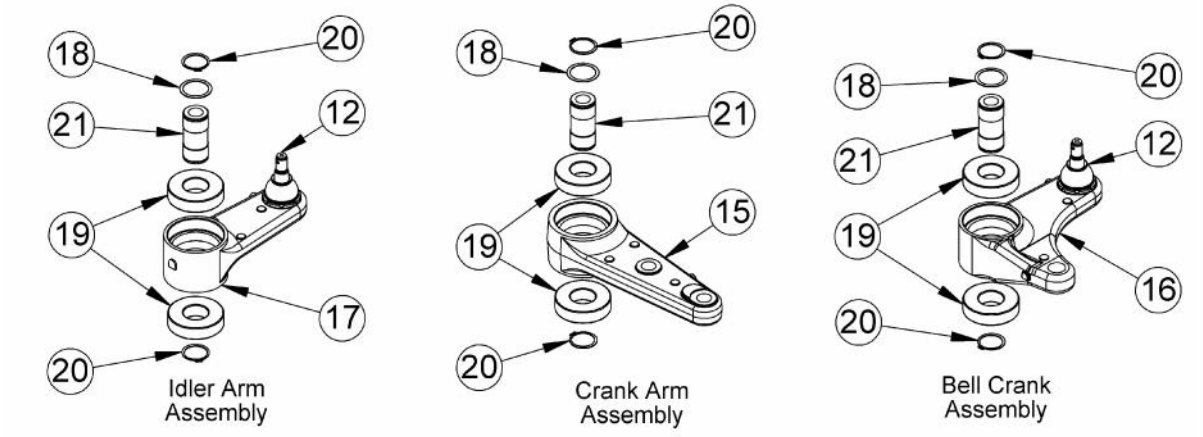


Steering Components

Item	Part No.	Description	Item	Part No.	Description
1	700973-01	Tie Rod Assembly, LH		K705382	Kit, Ball Joint and Hardware
2	700973-02	Tie Rod Assembly, RH	12	705382-01	*Ball Joint (40mm)
3	701924-01	Crank Arm Assembly	13	705382-02	*Slotted Nut, M20x1.5
4	700973-05	Crank Rod Assembly	14	705382-03	*Cotter Pin, 1.40 x .15 Dia.
5	705619-01	Bell Crank Assembly	15	701925-01	Crank Arm
6	702030-01	Relay Rod	16	700949-01	Bell Crank
7	705620-01	Idler Arm Assembly	17	700951-01	Idler Arm
8	167	Hex Head Bolt 1-14 x 6", Gr. 8		K710622	Kit, Bearing Replacement
9	89422312	Lock Nut 1", Gr. C	18	8654	**Shim
10	2571	Hardened Flat Washer 1"	19	701378-01	**Bearing
11	101445-P1	Cotter Pin- 1/8 X 1 1/2	20	6966	**Snap Ring
			21	7348	**Spacer

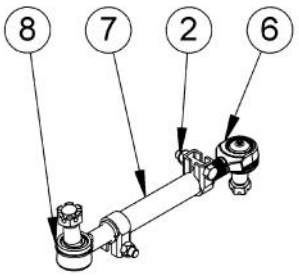
*Components of Ball Joint Kit K705382
*Components of Bearing Replacement Kit K710622



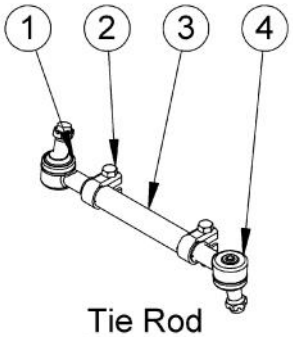


Tie Rod Assemblies

Item	Part No.	Description	Item	Part No.	Description
1	103712	Tie Rod End, RH	5	101445-P1	Cotter Pin (Not Shown)
2	6632	Clamp	6	710671-01	Tie Rod End, LH
3	700971-01	Tube, Tie Rod	7	700971-02	Tube, Crank Rod
4	103736	Tie Rod End, LH	8	710671-02	Tie Rod End, RH



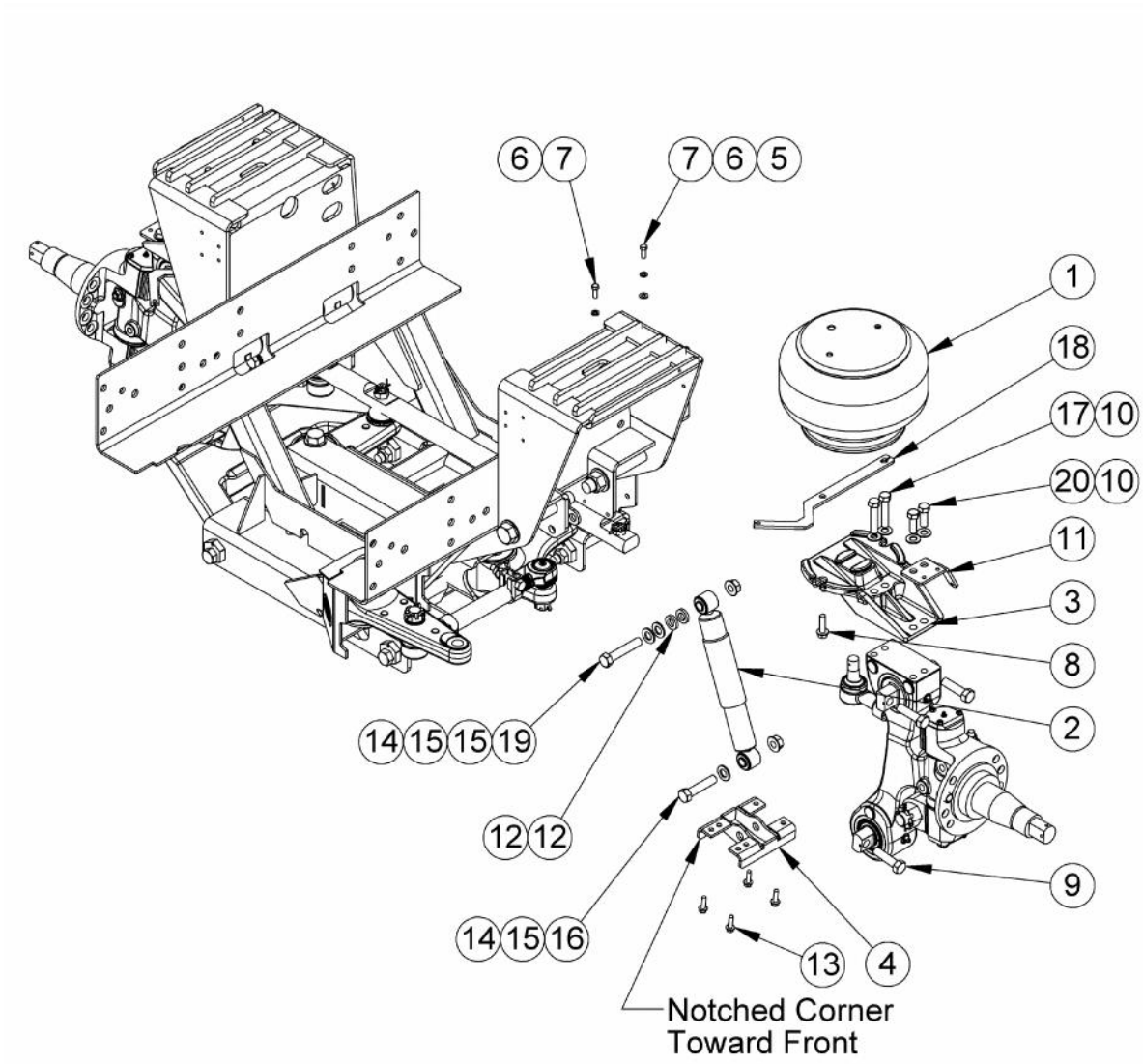
Crank Rod Assembly



Tie Rod Assembly

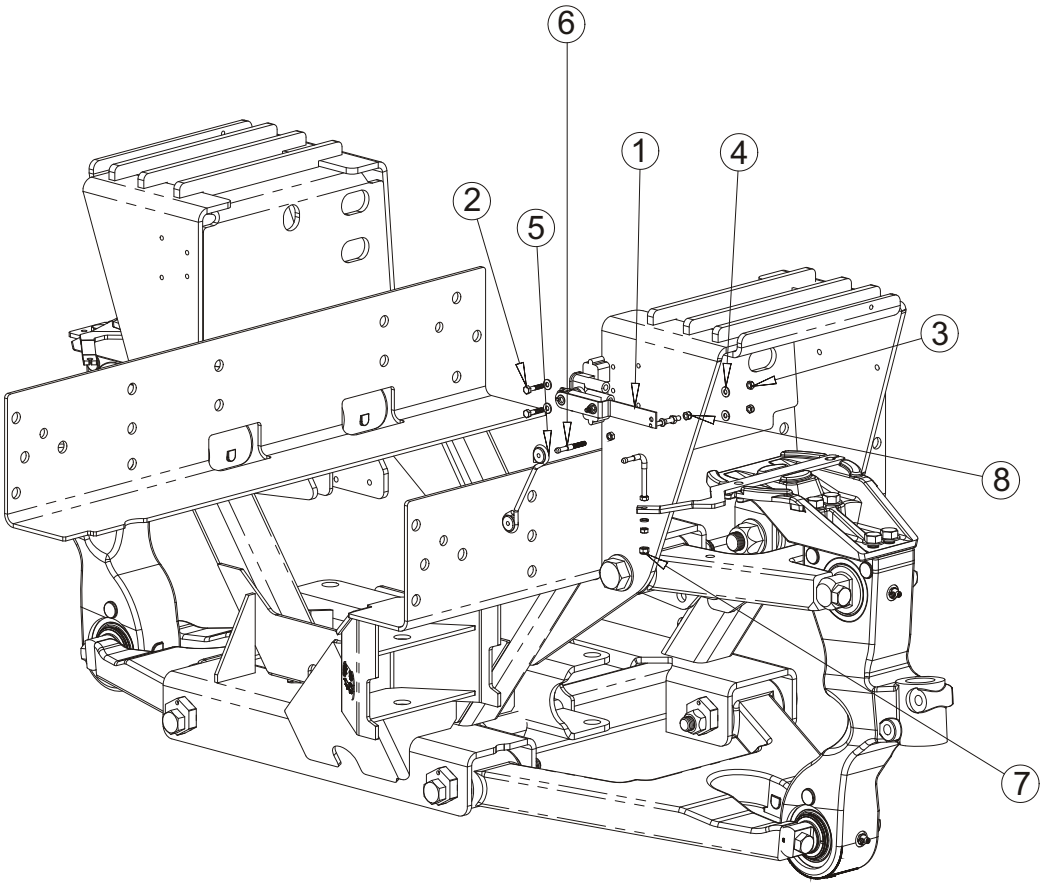
Air Spring and Shock Components

Item	Part No.	Description	Item	Part No.	Description
1	705951-01	Air Spring Assembly	11	706026-01	Brake Line Bracket, LH
2	700178-06	Shock Assembly		706026-02	Brake Line Bracket, RH
3	705692-01	Cast Lower Air Spring Mount, LH	12	152	HFW 3/4" (Used as Spacers on Forward Side)
	705692-02	Cast Lower Air Spring Mount, RH	13	302	FHB 3/8-16 x 1.25" Gr. 8 ZN
4	707357-01	Lower Shock Mount	14	208	LFN 3/4-10, Gr. G, ZN
5	263	HFW 3/8"	15	8131017	FW 3/4" .812 x 1.469 x .134, ZP
6	8120382	SLW 3/8"	16	100678-P1	HHB 3/4-10 x 3.5, Gr. 8, ZN
7	100263-P1	HHB 3/8-16 x 1, Gr. 8, ZN	17	149	HHB 5/8-18 x 3.00, Gr. 8, ZN
8	276	FHB 1/2-13x1.75 GR.8	18	706899-01	Height Control Arm
9	100039-P1	HHB 3/4-10 x 2.75, Gr. 8, ZN	19	100727-P1	HHB 3/4-10 x 4.00, Gr. 8, ZN
10	89422850	HFW 5/8"	20	700184-04	HHB 5/8-18 x 1 3/4, Gr. 8, ZN



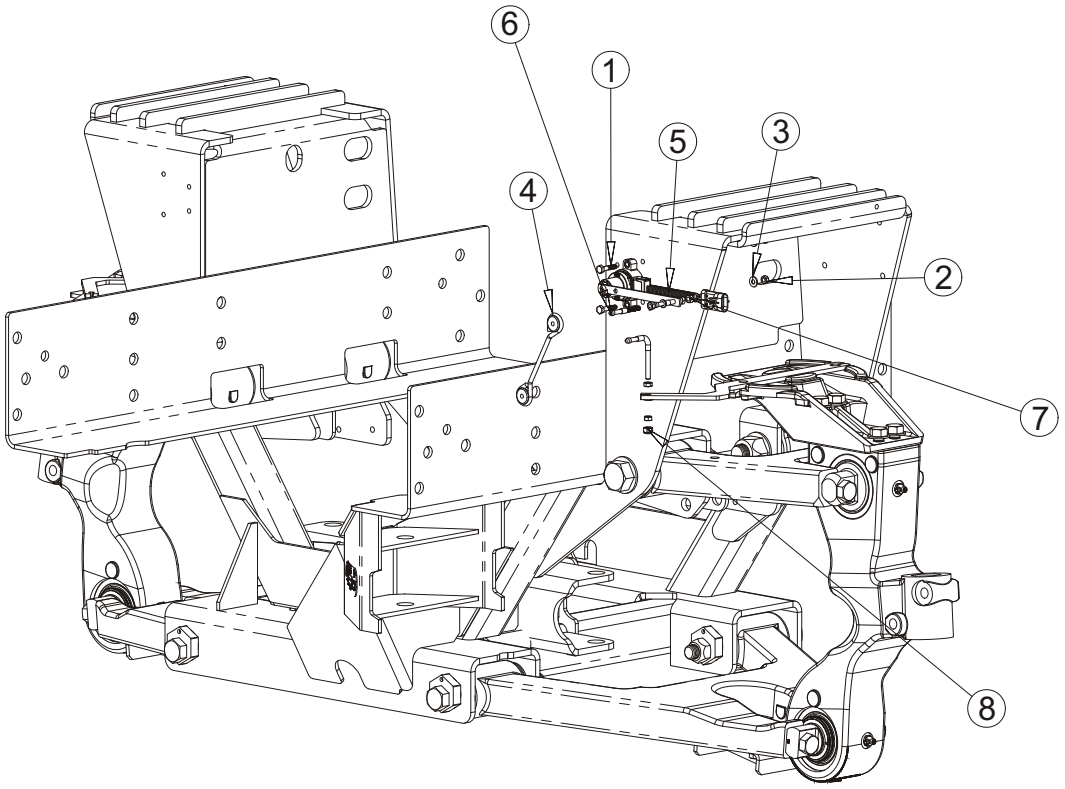
HCV Components (non-SHC Models Only)

Item	Part No.	Description	Item	Part No.	Description
1	5608	HCV, Standard	5	703915-01	Assembly, Linkage
2	702606-02	HHB 1/4-20 x 1.25”, Gr. 8, ZN	6	705932-01	Pin
3	100703-P1	LN 1/4”	7	705967-01	1/4” Nylock Nut
4	8120392	FW 1/4”	8	705967-02	5/16” Nylock Nut



Height Sensor Components (-SHC Models Only)

Item	Part No.	Description	Item	Part No.	Description
1	702606-02	HHB 1/4-20 x 1.25”, Gr. 8, ZN	5	705378-01	Height Control Sensor, Electronic
2	100703-P1	LN ¼”	6	705932-01	Pin
3	8120392	FW ¼”	7	705967-01	1/4” Nylock Nut
4	703915-01	Assembly, Linkage	8	705967-02	5/16” Nylock Nut

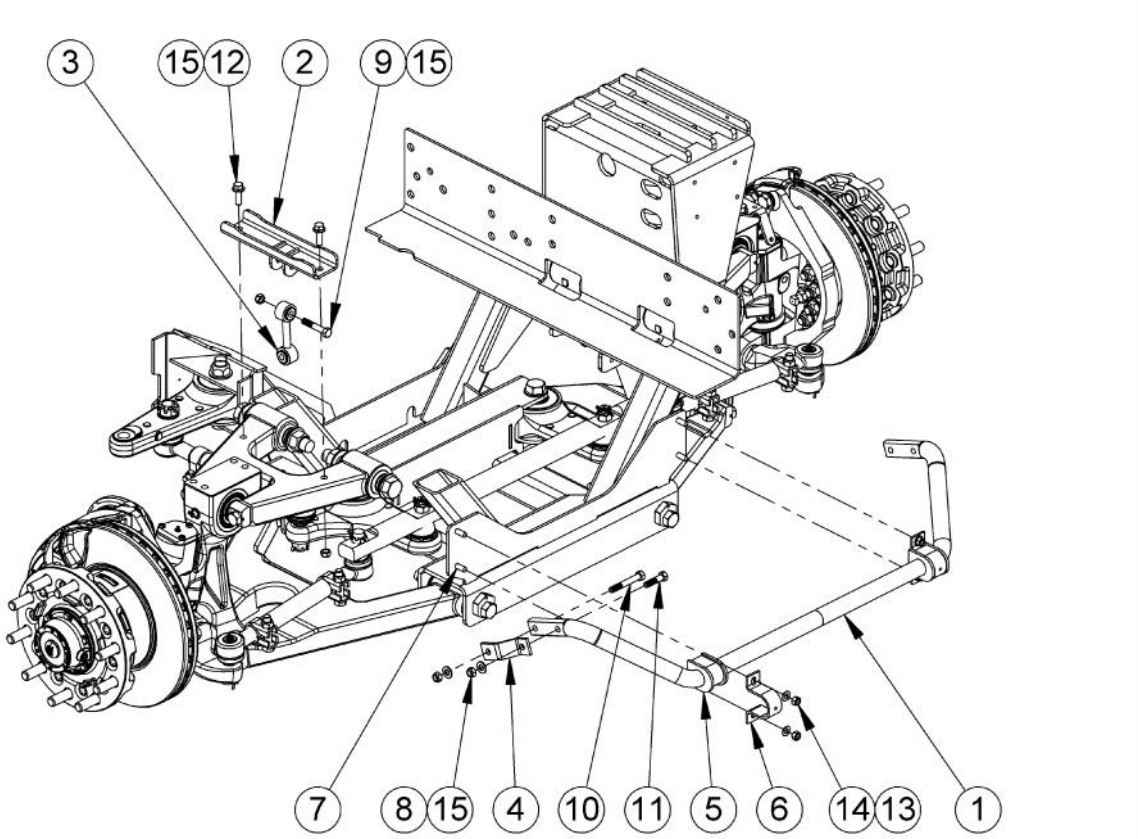


Sway Bar Components (-SB Models Only)

Item	Part No.	Description	Item	Part No.	Description
1	703124-01	Sway Bar	8	118	**FW 1/2" **
2	703165-01	Assembly, Mount, UCA, Sway Bar	9	102550	**HHB 1/2-13 x 2.75, Gr. 8, Zinc
	K706842	Kit, Sway Bar Mount	10	700144-23	**HHB 1/2-13 x3.50, Gr. 8, Zinc
3	703127-03	*Link, UCA, Sway Bar	11	8455001	**HHB 1/2-13 x 2.00, Gr. 8, Zinc
4	703128-01	*Mount, UCA, Sway Bar	12	307	**FHB 1/2-13 x 1.50, Gr. 8, Zinc
5	702895-02	*Bushing, Split, Sway Bar	13	702898-01	**Washer, Cut, Sway Bar
6	702894-01	*Mount, D-Ring Sway Bar	14	89422299	**LN 7/16-14, Gr. 8
	K705273	Kit, Sway Bar Fasteners	15	89422301	**LN 1/2-13, Gr. 8, Zinc
7	702797-01	**FHB 7/16-14 x 1.25, Gr. 8, ZP			

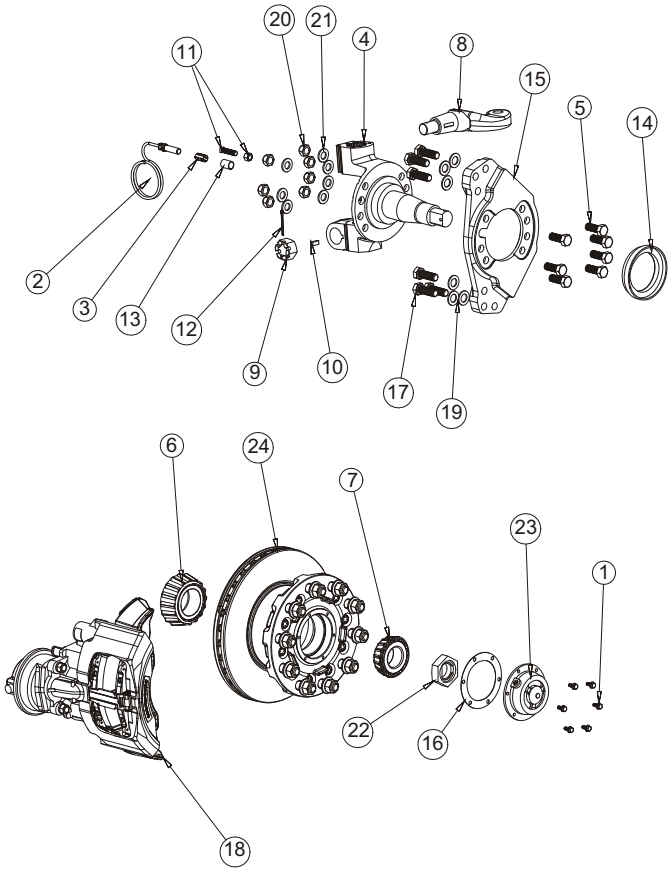
* Items included with K706842

** Items included with K705273



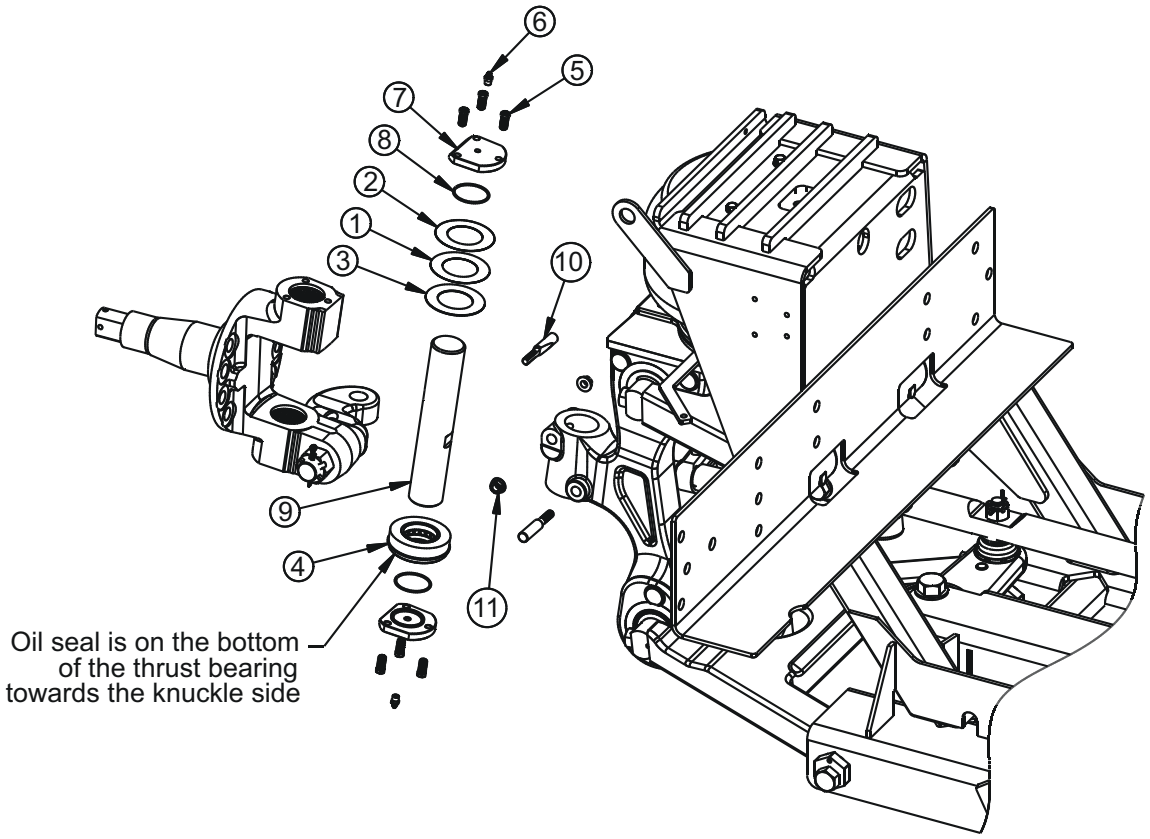
Disc Brake Components

Item	Part No.	Description	Item	Part No.	Description
1	266	Flange Head Bolt 5/16-18x.75, Gr. 5, ZC	13	705011-27	ABS Sensor Bushing
2	7328	ABS Sensor (Straight w/Lead)	14	705084-01	Oil Seal Assembly
3	6946	ABS Sensor Spring Retainer	15	705013-15	Torque Plate Assembly, LH
4	705011-01	Steering Knuckle Assembly, LH		705013-16	Torque Plate Assembly, RH
	705011-02	Steering Knuckle Assembly, RH	16	1786	Hub Cap Gasket
5	8223752	Hex Head Bolt ¾-16 x 2, Gr. 8, ZN	17	700690-04	Hex Head Bolt M20x1.5-50 Gr. 10.9
6	705051-01	Bearing Cone - Inner	18	705013-17	Caliper Assembly, LH
	705051-02	Bearing Cup - Inner		705013-18	Caliper Assembly, RH
7	705052-01	Bearing Cone - Outer		705013-04	Brake Pads (Set of 4)
	705052-02	Bearing Cup - Outer	19	703553-02	HFW M20 ZN
8	705017-01	Arm, Steering, LH	20	89422308	Lock Nut ¾-16 x .75, Gr. G, PH
	705017-02	Arm, Steering, RH	21	103003	HFW 3/4”
9	705011-21	Castle Nut 1¼ - 12	22	708181-01	Nut, Spindle, Pro-Torq
10	705011-26	Key	23	709226-01	Hub Cap
11	705011-22	Assembly, Steering Stop	24	707819-01	Hub and Rotor Assembly
12	705011-20	Cotter Pin 3/16 x 2-1/2			



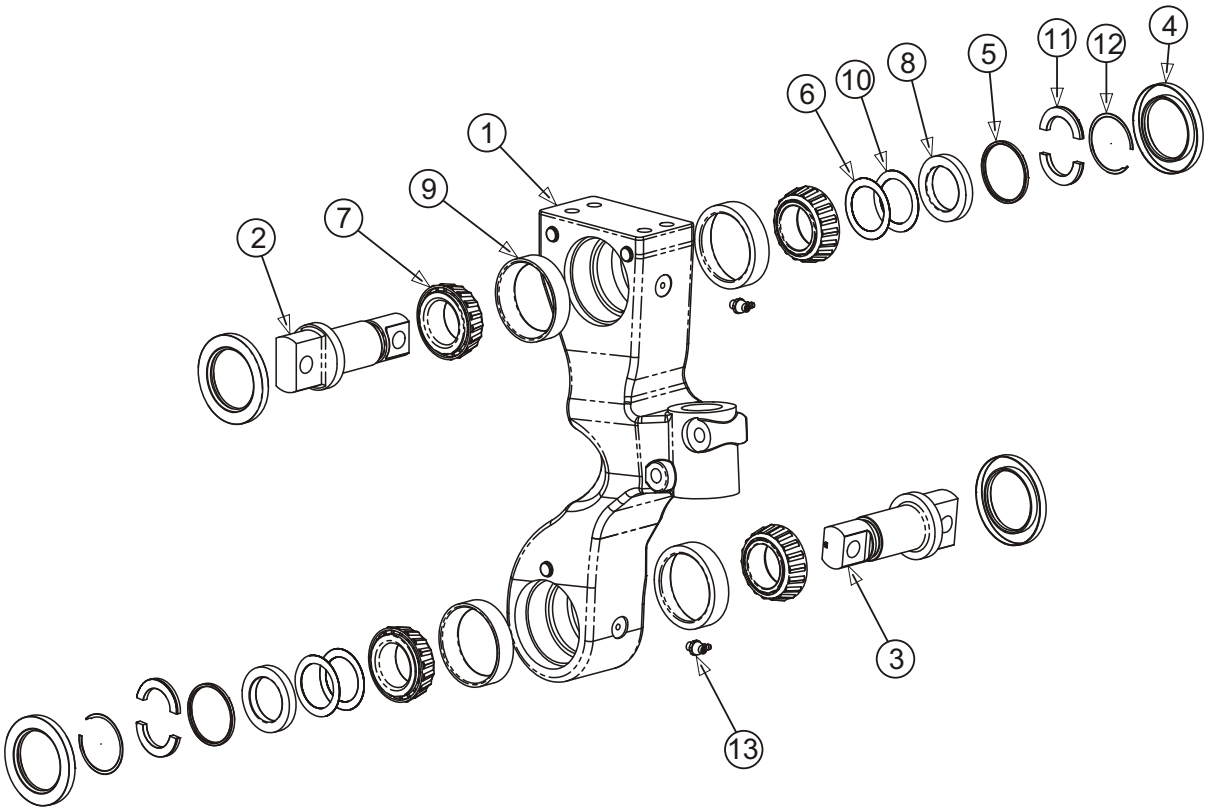
King Pin Components

Item	Part No.	Description	Item	Part No.	Description
1	705011-07	Shim, .005” thick	7	705011-17	Cap, King Pin
2	705011-08	Shim, .010” thick	8	705011-18	O-Ring
3	705011-09	Shim, .020” thick	9	705011-19	King Pin
4	705011-14	Assembly, Bearing, Thrust	10	705315-01	Draw Key, (Long 3.80)
5	705011-15	Bolt, King Pin Cap	11	705316-01	Nut, Draw Key
6	705011-16	Grease Fitting, Straight			



Steering Knuckle Carrier Components

Item	Part No.	Description	Item	Part No.	Description
1	705632-01	Machining, Carrier, LH	7	702834-01	Bearing Cone
	705632-02	Machining, Carrier, RH	8	702622-01	Spacer
2	702621-01	Upper Bar Pin	9	702835-01	Bearing Cup
3		Lower Bar Pin	10	702623-02	Shim, .010
4	702836-01	Seal	11	702618-01	Split Collar
5	702619-01	Outer Collar	12	702620-01	Retaining Clip
6	702623-01	Shim, .004	13	7352	Grease Zerk, Hydraulic Shutoff



Left Hand Steering Knuckle Carrier Shown

Lubricant Specifications and Intervals

COMPONENT	SERVICE INTERVAL	CHANGE INTERVAL	LUBRICANT SPECIFICATION
Rod Ends of Tie Rods & Crank Rod	Whichever comes first: Every oil change or every 6 months	N/A	Multi-Purpose Chassis Grease Premium Multi-Purpose Chassis Grease NLGI Grade 2
Kingpin	Whichever comes first: Every oil change or every 6 months	N/A	Multi-Purpose Chassis Grease Premium Multi-Purpose Chassis Grease NLGI Grade 2
Carrier Bearings[2]	Whichever comes first: 50,000 miles (80,000 kilometers) or once a year	N/A	Mobillith AW2 Amoco L Industrial 861 Exxon Ronex MP
Wheel End	1000 miles (1600 kilometers) Check fluid level	Whichever comes first: Seals replaced, brakes relined, 100,000 miles (160,000 km), or once a year	Gear Oil SAE 80W/90 or equivalent

1. Moly-disulfide type grease is not recommended since it may lower friction capabilities in the adjusting clutch parts of the automatic slack adjuster.
2. Use caution when using an automatic grease gun or seals could possibly be blown out and damaged.

General Lubrication

Proper lubrication practices are important in maximizing the service life of your ***Reyco****Granning*® Independent Front Suspension.

⚠ CAUTION

Do not mix lubricants of different grades. Do not mix mineral and synthetic lubricants. Different brands of the same grade may be mixed.

⚠ CAUTION

Never mix oil bath and grease packed wheel ends.

Ball Joints

The ball joints are lubricated and sealed for their service life and do not require lubrication. Check for oil or grease marks on the exterior of the seal and if found verify that the seal has not been ruptured. If the seal has been ruptured then the ball joint must be replaced because it cannot be re-lubricated.

Rod Ends on Tie Rods Crank Rod

1. Review lubricant specification and interval requirements before servicing.
2. Apply lubricant to grease fitting until new lubricant discharges from the dust boot (**Figure 4**).

Carrier Bearing and Kingpin

1. Apply lubricant to both upper and lower carrier bearings and kingpin bushings until new lubricant discharges from the carrier bearing seals and in between the steering knuckle kingpin housing and carrier.

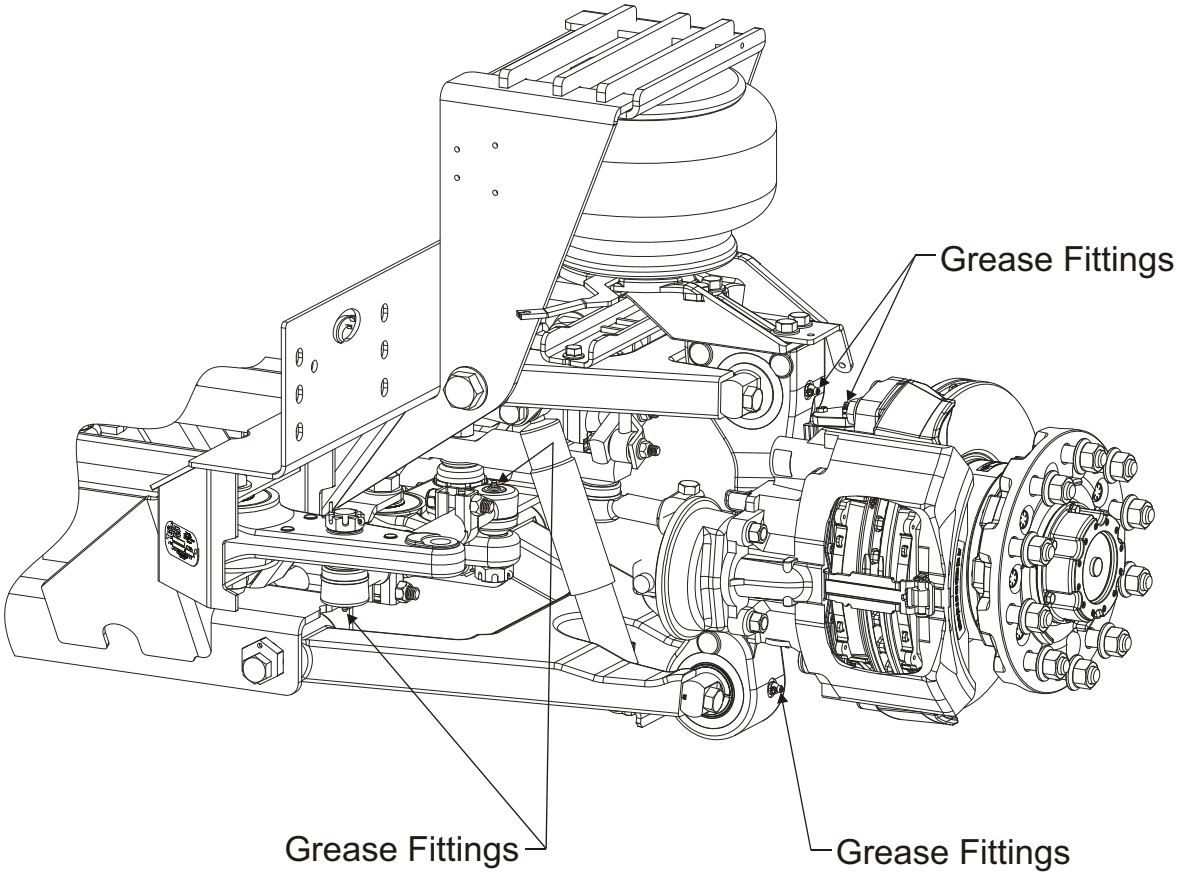


Figure 4 – Location of Lubrication Fittings

Note: Left side only shown

Wheel Bearings

1. Review lubricant specification and interval requirements before servicing.
2. Check oil level through hub cap window. If level is below the "add" level line then remove the pipe plug and fill with recommended oil until "full" level is achieved. (**Figure 5**). Add oil slowly since the heavy weight oil will settle slowly in the hub.

NOTE: The hub cap window can only be cleaned with mild soap and water. Aromatic solvents should not be used, as they will impair the transparency of the window.

3. Check the hub cap for external oil marks. The vent plug will normally weep a small amount of oil. Oil marks in other locations should be addressed by replacing the hub cap seal, window gasket, or tightening the pipe fill plug.

⚠ CAUTION

Do not remove or twist the red plug on the front of the hub cap. This will damage the hub cap, and cause oil to leak. Add oil only thru the pipe plug or warranty will be void.

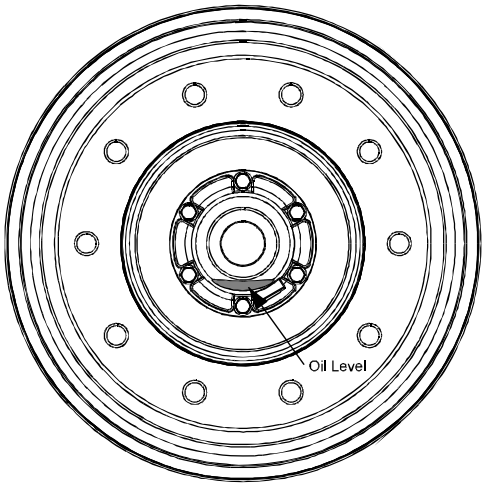


Figure 5 - Wheel Bearing Oil Level

Troubleshooting

SYMPTOMS	POSSIBLE CAUSES	REMEDIES
Tires wear out quickly or have uneven tire tread wear **Note:** *Wear pattern will indicate possible cause(s). Consult tire manufacturer for guidance.*	Tires have incorrect pressure	Put specified air pressure in tires.
	Tires out of balance	Balance or replace tires
	Incorrect toe-in setting	Adjust toe-in to specified setting
	Incorrect ride height	Adjust ride height to specified setting
	Incorrect rear axle alignment	Align rear axle to specified thrust angle
	Incorrect steering arm geometry	Adjust tie rod lengths as required
	Improper (mismatched) tires and wheels	Install correct tire and wheel combination
Vehicle is difficult to steer **Note:** *Engine must be running for power steering to be active and able to provide steering assist.*	Improper oversized tires	Install correct tire and wheel combination
	Tires not uniform	Install correct tire and wheel combination.
	Tires have incorrect pressure	Put specified air pressure in tires
	Incorrect steering arm geometry	Adjust tie rod lengths as required
	Steering arm assemblies binding	Check steering arm assembly bearings and lubricate as required
	Steering arm assembly ball joints binding	Inspect ball joints for wear and replace as required
	Tie rod ends binding	Inspect tie rod ends for wear and lubricate as required
	Kingpin binding	Inspect, lubricate, and repair as required.
	Steering column linkage binding	Align or adjust as required
	Steering miter box binding	Check steering miter box and repair or replace as required
	Steering gear valve binding	Inspect, repair or replace as required
	Steering wheel to column interference	Align or adjust as required
	Power steering pump fluid level low and/or possible leak in system	Add fluid, tighten connections and correct as required
	Power steering pump pressure and flow below specification	Conduct pump flow and relief pressure tests and adjust, repair or replace as required
	Air in power steering system	Add fluid, tighten connections and bleed system
	Contaminated or incorrect fluid	Replace with correctly specified fluid
	Obstruction with steering gear pitman arm or within hydraulic lines	Inspect, remove obstruction(s) and repair or replace as required
	Obstruction within wheelhouse	Inspect, remove obstruction(s) as required
	Excessive internal steering gear leakage	Inspect, repair or replace as required

SYMPTOMS	POSSIBLE CAUSES	REMEDIES
Vehicle wanders side-to-side…loose steering **Steering wheel has large amplitude, rotational oscillations when hitting large bumps**	Vehicle overloaded or unevenly loaded driver side to passenger side	Check wheel loads and correct as required
	Improper (mismatched) tires and wheels	Install correct tire and wheel combination
	Tires have incorrect pressure	Put correct air pressure in tires based on wheel load
	Incorrect toe-in setting	Adjust toe-in to specified setting
	Incorrect wheel caster setting	Adjust wheel caster to specified setting
	Tie rod end connection loose or ball stud worn	Inspect ball stud connections and wear
	Steering arm assembly mounts loose	Check and tighten to specification
	Steering arm assembly ball joints binding or worn	Inspect ball joints for wear or contamination and replace as required
	Kingpin worn	Check and replace as required
	Wheel bearings out of adjustment	Check wheel bearing end play and adjust as required
	Loose steering gear mounting	Check mounting and secure as required
	Loose pitman arm	Check pitman arm and tighten as required
	Steering column linkage worn	Check for wear and repair or replace as required
	Steering gear adjustment	Check and adjust to specification
	Steering column misaligned	Realign steering column as required
	Worn knuckle carrier bearings	Check, adjust, or replace as required
	Loose knuckle carrier mounting bolts	Check and tighten as required
	Loose Wheel Nuts	Check and tighten to specification
Vehicle pulls to one side without the brakes applied.	Vehicle overloaded or unevenly loaded driver side to passenger side	Check wheel loads and correct as required
	Improper (mismatched) tires and wheels	Install correct tire and wheel combination
	Tires have incorrect pressure	Put correct air pressure in tires based on wheel load
	Unequal ride height side to side	Inspect ride height and adjust to specified setting
	Improper brake adjustment	Inspect and adjust slack adjusters as required
	Incorrect rear axle alignment	Align rear axle to specified thrust angle
	Incorrect caster and/or camber setting	Check and adjust as required
	Wheel bearings out of adjustment	Check wheel bearing end play and adjust as required
	Loose steering gear mounting	Check mounting and secure as required
	Tie rod end connection loose or ball stud worn	Inspect ball stud connections and wear
	Bent spindle or steering arm	Inspect and replace as required
	Frame or underbody out of alignment	Inspect and correct as required
	Incorrect toe-in setting	Adjust toe-in to specified setting
	Mis-aligned belts in radial tires	Check and replace as required
	Steering gear valve binding	Inspect, repair or replace as required
	Steering gear not centered	Inspect and adjust as required
	Excessive internal steering gear leakage	Inspect, repair or replace as required
	Excessive water puddling on road	Avoid water puddles on road

SYMPTOMS	POSSIBLE CAUSES	REMEDIES
Vehicle pulls to one side with the brakes applied	Grease, oil or dirt on brake pads	Replace brake pads as required
	Brake pads are glazed	Deglaze brake pads by burnishing or replace as required
	Brake pads are not a balanced set, different friction codes or pad brand	Replace brake pads as required
	Loose or broken brake pads	Replace brake pads as required
	Brake rotor warped	Re-machine or replace brake rotor as required
	Defective brake rotor	Inspect for defects and replace as required
	Brake air chamber clevis pin or camshaft binding	Check and lubricate as required
	Uneven brake adjustment side to side	Adjust Caliper as required
	Different brake air chamber size side to side	Replace with same size brake air chambers
	Brake chambers air pressure uneven side to side	Check side-to-side air pressure and correct as required
	Rear axle brakes misadjusted or contaminated	Check, adjust, or replace as required
	ABS system malfunction	Check ABS system for proper function
	Air leak or obstruction in air brake lines	Check fittings with soapy water solution and remove obstructions
	Brake air chamber air leak or diaphragm damaged	Check chamber for air leak and damaged diaphragm
	Excessive water puddling on road	Avoid water puddles on road
Vehicle rolls side to side excessively	Front and/or rear shock absorbers worn	Replace shock absorbers as required
	Shock mounting loose	Check and tighten as required
	Shock eye bushings worn	Check and replace as required
	Sway bar bushings worn	Check sway bar bushings and replace as required
	Sway bar mounting brackets loose	Check sway bar mounting brackets and tighten as required
	Control arm pivot bushings worn	Inspect and replace as required
	Internal leak in height control valve	Check height control valve and replace as required
Front tires lock up during hard braking or ABS malfunction light remains lit	ABS sensor malfunction	Inspect ABS sensor installation and replace sensor as required
	ABS CPU or system malfunction	Check and repair or replace as required
	ABS sensor electrical connection faulty	Check ABS sensor connection and lead wire
	Tone ring on hub damaged	Check for damage and replace as required

SYMPTOMS	POSSIBLE CAUSES	REMEDIES
Vehicle ride is too harsh and/or suspension contacts stops excessively	Front shock absorbers worn	Replace shock absorbers as required
	Incorrect ride height	Adjust ride height to specified setting
	Vehicle overloaded	Check wheel loads and correct as required
	Air spring supply lines leaking or obstructed	Check air line connections and remove obstructions
	Vehicle system air pressure below specification	Check air pressure and correct as required
	Rebound bumper worn or missing	Check and replace as required
	Jounce bumper in air spring worn or broken	Check and replace air spring as required
Vehicle ride is too soft	Front shock absorbers worn	Replace shock absorbers as required
	Incorrect ride height	Adjust ride height to specified setting
Vehicle has unequal turning radius right to left	Incorrect steering arm geometry	Adjust tie rod lengths as required
	Steering gear not centered	Inspect and adjust as required
	Steering gear poppet valves set incorrectly	Check wheel turn angles and adjust as required
	Tie rod clamps positioned improperly	Check orientation and adjust as required
Suspension does not maintain ride height	Air leak	Check connections with soapy water solution and repair or replace as required
	Internal leak in height control valve	Check height control valve and replace as required
	Height control valve linkage loose	Check and tighten linkage as required
	Air spring chafed or worn	Check air spring and Replace as required
Brakes are noisy	Grease, oil or dirt on brake pads	Replace brake pads as required
	Brake pads are glazed	Deglaze brake pads by burnishing or Replace as required
	Brake pads are not a balanced set, different friction codes or brand	Replace brake pads as required
	Loose or broken brake pads	Replace brake pads as required
	Brake Rotor Warped	Re-machine or Replace as required
	Defective Brake Rotor	Inspect for defects and Replace as required

Refer to Bendix Disc Brakes manual Y006471 for troubleshooting of the disc brakes or contact Customer service at 1-800-247-2725.

Inspection

General Inspection

Perform a thorough visual inspection of the suspension to ensure proper assembly and to identify broken parts and loose fasteners each time the vehicle suspension is serviced. Do the following during an inspection.

Wheel Alignment - Follow the guidelines in the Front Wheel Alignment section for wheel alignment inspection intervals. Check wheel alignment if excessive steering effort, vehicle wander, or abnormal tire wear is evident.

Fasteners - Check that all the fasteners are tightened to the proper tightening torque. Use a calibrated torque wrench to check torque.

Wear and Damage - Inspect components of the suspension for wear and damage. Look for bent or broken components. Replace all worn or damaged components.

Operation - Check that all components move freely through the complete wheel turning arc.

⚠ CAUTION

Reyco Granning LLC recommends replacing any damaged or out-of-specification components. Reconditioning or field repairs of front suspension components is prohibited. Some cast components are heat-treated. These components as well as other non-heat treated castings cannot be bent, welded, heated, or repaired in any way without reducing the strength or life of the component thus voiding the warranty. Only genuine *ReycoGranning*® replacement components are allowed.

⚠ WARNING

Never work under a vehicle supported by only a jack(s). Jacks can slip or fall over and cause serious personal injury. Always use safety stands. Do not place jacks or safety stands under the lower control arms to support the vehicle. Lower control arms are not stationary components and could move allowing the vehicle drop causing serious personal injury.

The vehicle may be supported on safety stands by the suspension sub-frame or chassis frame for inspections that require removal of the wheel and tires or deflation of the air springs. Always secure the vehicle by setting the parking brake and block the drive wheels to prevent vehicle movement before inspections.

Inspecting the Control Arm Bushings for Wear

NOTE

It is recommended that the bushings in all of the control arms be replaced at the same time if one is found worn.

1. Check clearance between each control arm and sub-frame bushing mount. Look for contact pattern as evidence of bushing wear. Replace worn bushings in both control arm housings as needed.
2. Check for bushing bulging between the control arm and sub-frame mount or presence of small rubber particles near sub-frame bushing mount.

3. Check that the control arm mounting bolts are tight. Recommended torque is **465-485 ft-lb** for lower control arms and **950-1050 ft-lb** for upper control arms (See Torque Table). A loose joint will result in wear between the bushing inner sleeve and sub-frame mount.

Inspecting the Tie Rod Ends

⚠ WARNING

Do not use a wrench or other object to apply leverage when inspecting tie rod end sockets. Applying leverage can yield incorrect results and damage components. Component damage can lead to the loss of steering control.

1. With the engine on, lightly rock the steering wheel and have an assistant observe any looseness in the two mating tapers or any movement of the stud nut at both ends of the tie rod. (**Figure 6**). If looseness is found in either place go to step 2, otherwise skip to step 3.
2. Remove the tie rod end ball stud from the taper mount and visually inspect both. If either of the mating tapers shows distortion or wear, then both components must be replaced. Torque Tie Rod Castle Nuts to **90-100 ft-lb** (See Torque Table).
3. With the engine off and the wheels steered straight ahead, grab the tie rod near its end and try to move the socket in a direction parallel to the ball stud axis (**Figure 6**). Be sure to only apply hand pressure to the tie rod.
4. Measure the axial movement with a scale. If the movement is greater than 1/8 inch (3mm) replace the tie rod end immediately. If the socket moves but the movement is less than 1/8 inch (3mm) then the tie rod end should be replaced before 1/8" (3mm) movement occurs.
5. Check dust boot for damage. Replace as needed.
6. Check tie rod clamp orientation (**Figure 6**)

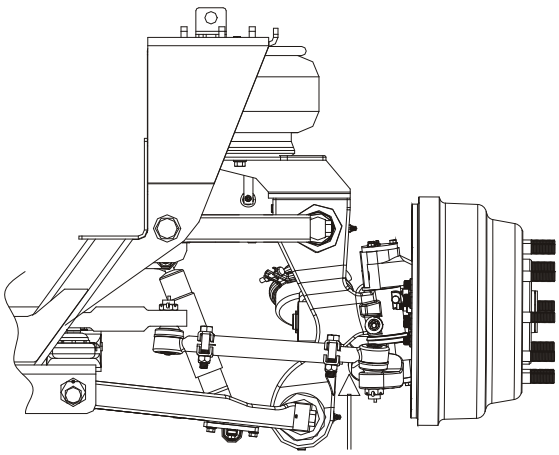


Figure 6 - Tie Rod

Inspecting the Brake System

Brake System

The suspension system is equipped with Bendix ADB22X air brakes. Refer to Bendix service data publication SD-23-7541 for inspection and service procedures.

Inspecting the ABS Sensor and Tone Ring

1. The wheels and may need to be removed to ease inspection of tone ring and sensor.
2. Disconnect the ABS sensor lead from the chassis connector.
3. The ABS sensor test will require a voltmeter that can measure AC voltage on a 0-10V scale.
4. Connect the voltmeter to the connector pins of the ABS sensor lead.
5. Set the voltmeter scale to millivolts and the voltage source to AC volts.
6. Rotate the wheel hub by hand and record the voltage output from the ABS sensor. A minimum output of 0.8V AC is normal.
7. If the minimum voltage output is not achieved, check lead wire connections and repeat Step 3. Otherwise, if the minimum voltage output is not achieved after repeating Step 3 then go to Step 5.
8. Check physical gap between the sensor and tone ring (**Figure 7**). The maximum allowable gap is .027 inch. If the gap is greater than .027 inch, press on the wire lead end of the sensor and push the sensor into contact with the tone ring. Check that the ABS spring retainer and bushing are not unseated. Re-seat components as needed.
9. Inspect the tone ring on the hub for physical damage and proper installation onto the hub. The tone ring should have a maximum run out of .008 inch relative to the hub/spindle centerline.
10. Repeat Step 3. If voltage output is less than 0.8V AC then replace the ABS sensor.

NOTE: Check voltage output of new sensor.

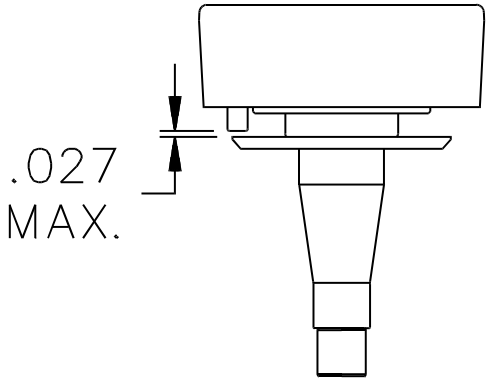


Figure 7 - ABS Sensor and Tone Ring Gap

Inspecting the Shock Absorber

1. Check shock absorbers for oil leakage, bent components, missing or broken components, excessive corrosion, or worn bushings. Replace shock absorbers if any of the above items is present.

Inspecting the Air Spring and Height Control Valve

Air Spring Inspection

1. Refer to Firestone's Preventative Maintenance Checklist for additional air spring information.
2. Check the outside diameter of the air spring for irregular wear or heat checking.
3. Check airlines to make sure contact does not exist between the airlines and the outside diameter of the air spring. Re-secure airlines to prevent contact as needed. Check for airline and fitting leaks with soapy water solution.
4. Check to see that there is a minimum of 1-inch clearance around the circumference of the air spring while it is energized with air.
5. Check the air spring piston for buildup of foreign material. Remove any foreign material that is present.

Height Control Valve Inspection

1. Check the height control valve and linkage for damage. Replace components as needed.
2. Dump and re-inflate the air suspension.
3. Verify the ride height by measuring from wheel center to the bottom of the frame ("A") or air spring height ("B"). If the dimensions are not within +/- .125" of (**Figure 8**), readjust.
4. The actuation arm of the height control valve should be horizontal at ride height (**Figure 8**). See section for adjusting to correct ride height.

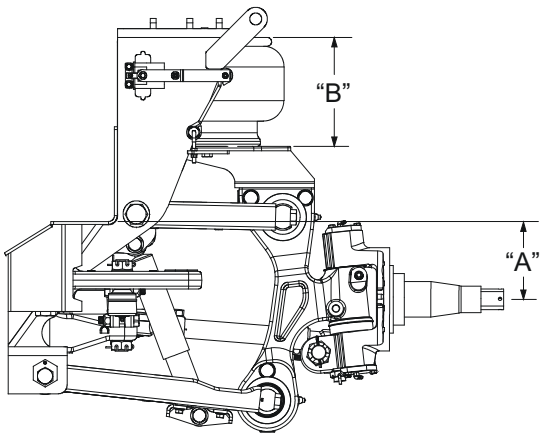


Figure 8 - Ride Height Measurement

Unit	Ride Height "A"	Air Spring "B"
IFS1700S	6.61"	9.25"

Inspecting the Idler Arm & Crank Arm Bearings

1. Check that steering arm assembly pivots are free of foreign material and bearing seals are in place.
2. Start vehicle engine. Oscillate the steering wheel and observe the motion of the steering arm assemblies (**Figure 9**). The steering arm assemblies should not exhibit any noticeable conical motion about their pivot axes.
3. If any conical motion is observed check pivot bolt torque which should be **575-625 ft-lb** (See Torque Table). Otherwise, replace the bearing set of the steering arm assembly that exhibits conical motion.

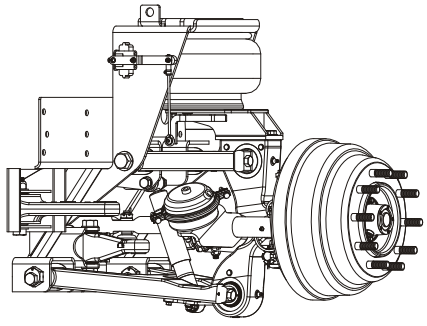


Figure 9 - Steering Arm Assemblies

Inspecting the Relay Rod Ball Joints

Seal Inspection

1. Inspect the ball joint seal outer surface for presence of oil "wetting". The entire outer seal surface should be dry. Use a mechanics mirror and flashlight to inspect the entire seal. Use a blunt object as needed to inspect between seal convolutes.
2. If oil "wetting" is found, then inspect the entire wet area to confirm the seal has a rupture(s) and oil source is from internal grease leaking from the ball joint. If seal is ruptured, then the ball joint must be replaced.
3. Skip ball joint endplay measurement.

NOTE

Care must be taken to not damage ball joint seals during inspection. Seals that are ruptured during inspection must be replaced. Do not apply excessive force to pry ball joints.

Endplay Inspection

1. Install a dial indicator with a magnetic base so that the base is fixed to the steering arm assembly. Place the indicator tip on the flat area of the Relay Rod adjacent the castle nut.
2. Using a C-clamp, squeeze the Relay Rod and the steering arm assembly together to seat the ball joint. Do not apply excessive clamp load.
3. Set the dial indicator on "zero".
4. Release the clamp. Place the pry bar between the steering arm assembly and the Relay Rod. **Do not allow the pry bar to contact the ball joint seal.** Firmly pry upward using the steering arm assembly as a fulcrum to lift the Relay Rod. The pry load must not cause the Relay Rod to rotate thus causing the Relay Rod to change orientation.
5. Record the dial indicator reading. A reading greater than .040" will require ball joint replacement.
6. Inspect ball joint seal for damage and replace the ball joint if damaged during measurement process.

Inspecting Wheel Bearing Endplay

1. Remove the tire and wheel.
2. Remove the hub cap.
3. Attach a dial indicator with a magnetic base to the face of the hub.
4. Place the tip of the dial indicator on the center of the steering knuckle spindle. Set the dial indicator on zero. (**Figure 10**).

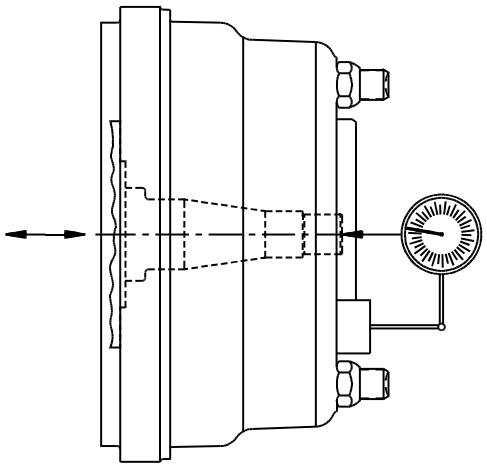


Figure 10 - Wheel End Play Measurement

NOTE
Do not push/pull at the top and the bottom of the hub. Pushing or pulling at the top and the bottom will not yield a true measurement of the endplay.

5. Measure the endplay by simultaneously pushing/pulling on opposite sides of the hub while observing the dial indicator. The endplay is the total travel observed. If the endplay is not within .001-.005", see the section on adjusting the wheel bearing endplay.

Inspecting the Knuckle Carrier Bearing and Seal

1. Inspect the seals for damage.
2. Place the magnetic base of a dial indicator on the knuckle carrier and position the tip of the dial on the end of the bar pin such that axial movement can be measured.
3. Set the dial indicator to "0" (zero).
4. Place a pry bar between the control arm and carrier and pry to measure axial movement of the bar pin. Do not pry on seal. Measure and record the dial indicator reading.
5. If the axial endplay is more than "0" inch, then replace the carrier bearings. See repair section on knuckle carrier.

Inspecting the Kingpin Vertical Endplay

1. Turn the tire straight ahead.
2. Place the magnetic base of a dial indicator on the knuckle carrier and position the tip of the dial on top of the king pin bearing cap such that vertical movement can be measured.
3. Place a portable jack and a suitable block (one with clearance for the grease fitting) under the lower king pin grease cap area.
4. Set the dial indicator to "0" (zero).
5. Raise the jack until the dial indicator shows the end of vertical travel. Measure and record the dial indicator reading. Vertical inspection clearance must be .006-.012 inches.
6. If the steering knuckles binds or less than .001 inch endplay is measured, remove shims from the shim pack. See repair section for kingpin.
7. If the vertical endplay measurement is more than .012 inches, then install shims. See repair section for kingpin.

Adjusting Wheel End Play

⚠ WARNING

Never work under a vehicle supported by only a jack(s). Jacks can slip or fall over and cause serious personal injury. Always use safety stands. Do not place jacks or safety stands under the lower control arms to support the vehicle. Lower control arms are not stationary components and could move allowing the vehicle drop causing serious personal injury.

⚠ WARNING

Failure to follow this instruction could cause the wheel to come off and cause bodily injury. The PRO-TORQ® Spindle Nut is sold as an assembly with the keeper in place. DO NOT attempt to place the nut on the spindle or tighten or loosen the nut on the spindle while the keeper is locked inside the nut. Doing so may deform the keeper and allow the nut to unthread during operation.

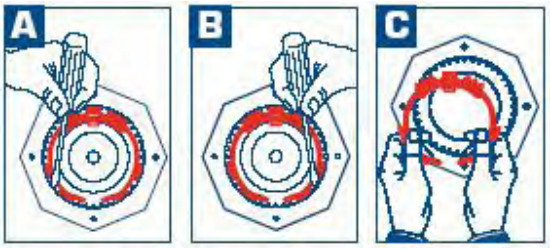
1. Secure the vehicle by setting the parking brake and block the drive wheels to prevent vehicle movement.
2. Raise the vehicle until the front wheels are off the ground. Support the raised vehicle with safety stands.
3. Place an oil drip tub beneath the hub to catch oil. Rotate the hub such that the hub cap drain plug is facing upwards. Remove the drain plug from the hub cap and place it in a container for re-installation.
4. Rotate the hub such that the drain hole faces downward and drain the oil from hub cavity. Wait a few minutes for most of the oil to drain before continuing to the next step.
5. Remove the hub cap bolts, hub cap, and gasket. Take care not to damage the gasket for re-installation. Place the components in a location to prevent contamination.

NOTE: Solvents may damage the hub cap window.

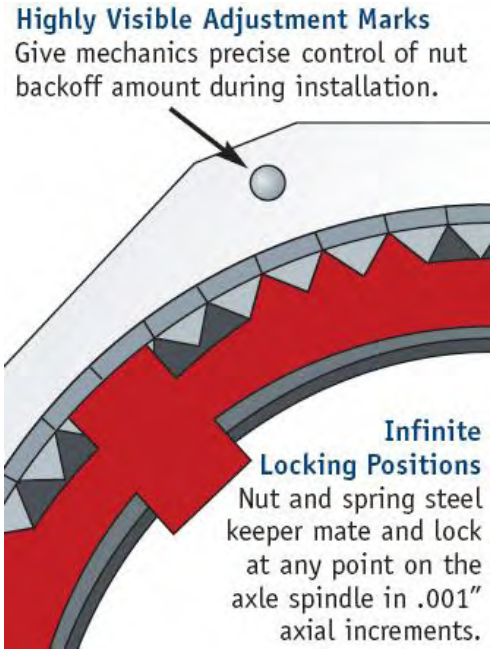
NOTE

When removing or installing the inner and outer spindle nuts, use the correct wrench sockets to avoid damaging the nuts. Do not use impact driver to tighten inner and outer nuts. Only use a torque wrench to tighten the nuts.

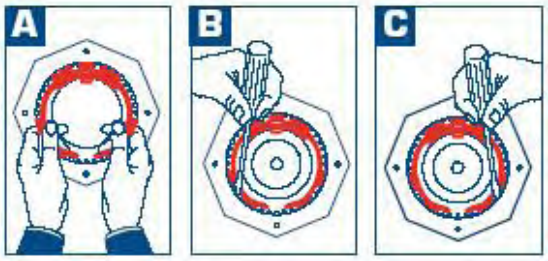
6. Remove the keeper from the nut.



7. A, B, C Use a small screwdriver to carefully pry the keeper arm from the undercut groove on each side until the keeper is released.
8. Seat the bearing, with the hub rotor only, using a torque wrench.
9. Tighten the nut to 200 ft-lb. Spin the wheel at least one full rotation.
10. Repeat step #9 two more times.
11. Back the nut off until it is loose.


Highly Visible Adjustment Marks
Give mechanics precise control of nut backoff amount during installation.
Infinite Locking Positions
Nut and spring steel keeper mate and lock at any point on the axle spindle in .001" axial increments.

12. Adjust the bearing by tightening the nut to 100 ft-lb. Spin the wheel at least one full rotation.
13. Repeat step #12 two more times.
14. Back the nut off one raised face mark (1/4 turn).
15. Install the keeper with the orange side facing out.
16. Align the flat of the keeper with the milled flat on the spindle and insert the single keeper tab into the undercut groove of the nut. Install the keeper with the orange side facing out.
17. Engage the mating teeth.



18. Compress and insert the keeper arms, one at a time, into the undercut groove with a small screwdriver.
19. Verify the end play
20. Attach a dial indicator with a magnetic base to the face of the hub rotor.
21. Place the tip of the dial indicator on the center of the steering knuckle spindle. Set the dial indicator on zero.
22. Measure the endplay by simultaneously pushing/pulling on opposite sides of the hub rotor while observing the dial indicator. The endplay is the total travel observed. If the endplay is not within .001-.005", a readjustment will be required.
23. Install hub cap gasket and hub cap. Tighten the cap screws in sequence to **20-30 ft-lb** (See Torque Table). Replace the hub cap vent plug if removed.
24. Fill the hub cavity with the appropriate amount and type of lubricant and secure drain plug.
25. Check oil level through the hub cap window (**Figure 5**). If level is below the "add" level line, then fill with recommended oil until "full" level is achieved. Add oil slowly since the heavy weight oil will settle slowly in the hub.

NOTE: The hub cap window can only be cleaned with mild soap and water. Aromatic solvents should not be used, as they will impair the transparency of the window.

26. Check the hub cap for external oil leakage at the drain plug or gasket. For leaks at the drain plug check for application of thread sealant to threads and tightness. For leaks at the gasket, replace the gasket. The vent plug will normally weep a small amount of oil.

Adjusting Suspension Ride Height

The height control valve (HCV) and linkage should be checked regularly for proper clearance, operation and adjustment.

NOTE

Improperly adjusted ride height will result in incorrect wheel alignment measurements and may result in abnormal tire wear. Check the ride height prior to front suspension alignment.

The ride height of the front suspension is the distance from the bottom of the chassis frame rail to the center of the wheel spindle. An alternate measurement may be taken as the height of the air spring (**Figure 11**).

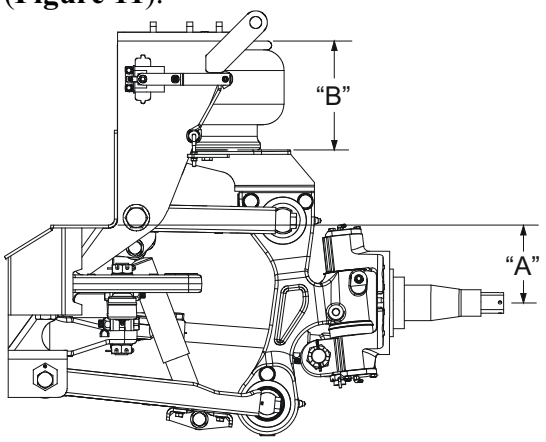


Figure 11 – Measurement at Ride Height

Unit	Ride Height "A"	Air Spring "B"
IFS1700S	6.61"	9.25"

Properly adjusted ride height results in correct suspension travel and alignment. The ride height should not be adjusted to adjust chassis rake angle.

⚠ CAUTION

Adjusting the ride height can cause the front end to raise or lower unexpectedly due to vertical movements at the connection of the vertical link and the horizontal arm of the height control valve.

1. Park the vehicle on a level surface.
2. Exhaust or "dump" and re-inflate the air suspension. Allow the Suspension to settle.
3. Check ride height of rear suspension:

   A: On vehicles with front suspension equipped with (2) height control valves, check and adjust the rear suspension first.

   B: On vehicles with front suspension equipped with a single height control valve, check and adjust the rear suspension after finish adjusting the front.

4. Measure either the wheel center to bottom of frame ("A") or air spring height ("B"). If the dimensions are not within ±1/8" of measurements in **Figure 11**, adjust as follows.

   A: Loosen the height control valve linkage stud retaining nuts.

   B: Raise or lower the L-shaped linkage stud as necessary.

   C: Tighten the retaining nuts.

NOTE: It is recommended that the upper and lower studs be positioned parallel to each other. Torque to **8-12 ft-lb**.

5. After adjusting the length, it is recommended to dump and re-inflate the air suspension to obtain the ride height. Allow the suspension to settle.

6. If not already completed, adjust the rear suspension per manufacturer's recommendations.
7. Verify at each axle that the side-to-side ride heights are within .25" of each other.

Adjusting Wheel Bearing Endplay

1. Secure the vehicle by setting the parking brake and block the drive wheels to prevent vehicle movement.

⚠ WARNING

Never work under a vehicle supported by only a jack(s). Jacks can slip or fall over and cause serious personal injury. Always use safety stands. Do not place jacks or safety stands under the lower control arms to support the vehicle. Lower control arms are not stationary components and could move allowing the vehicle drop causing serious personal injury.

2. Raise the vehicle until the front wheels are off the ground. Support the raised vehicle with safety stands.
3. Remove the tire and wheel.
4. Place an oil drip tub beneath the hub to catch oil. Rotate the hub such that the hub cap drain plug is facing upwards. Remove the drain plug from the hub cap and place it in a container for re-installation.
5. Rotate the hub such that the drain hole faces downward and drain the oil from hub cavity. Wait a few minutes for most of the oil to drain before continuing to the next step.
6. Remove the hub cap bolts, hub cap, and gasket. Take care not to damage the gasket for re-installation. Place the components in a location to prevent contamination.

NOTE: Solvents may damage the hub cap window.

NOTE

When removing or installing the inner and outer spindle nuts, use the correct wrench sockets to avoid damaging the nuts. Do not use impact driver to tighten inner and outer nuts. Only use a torque wrench to tighten the nuts.

7. Remove the cotter pin and loosen the spindle nut.
8. Seat the bearings by tightening the spindle nut to 200 ft-lb. while rotating the wheel in both directions.
9. After torquing the castle nut to 200 ft-lb, rotate the hub and rotor ten (10) complete revolutions.
10. Loosen the spindle nut 1/2 turn and then tighten the nut to 50 ft-lb.
11. Back off the spindle nut 1/8 turn.
12. Verify that wheel endplay is between .001-.005 inches. (See inspecting wheel endplay section). If not, loosen spindle nut, re-index the spindle nut accordingly, and repeat Steps 9 thru 12 until proper endplay is achieved.
13. Install cotter pin and bend over, if cotter pin hole is not lined up, loosen nut to first locking position.

⚠ CAUTION

Never tighten the spindle nut to align the cotter pin with hole in locking washer. This can pre-load the bearings and cause premature bearing failure.

14. Install hub cap gasket and hub cap. Tighten the cap screws to 20-30 ft-lb (See Torque Table). Replace the hub cap vent plug if removed.
15. Fill the hub cavity with the appropriate amount and type of lubricant and secure drain plug.
16. Check oil level through the hub cap window. (**Figure 5**). If level is below the "add" level line, then fill with recommended oil until "full" level is achieved. Add oil slowly since the heavy weight oil will settle slowly in the hub.

NOTE: The hub cap window can only be cleaned with mild soap and water. Aromatic solvents should not be used, as they will impair the transparency of the window.

17. Check the hub cap for external oil leakage at the drain plug or gasket. For leaks at the drain plug check for application of thread sealant to threads and tightness. For leaks at the gasket, replace the gasket. The vent plug will normally weep a small amount of oil.

Adjusting the Maximum Wheel Turn Angle

⚠ CAUTION

Do not adjust maximum wheel turn angle greater than 55°. Mis-adjustment of the wheel turn angle can cause damage to steering system components.

The turn angle may require adjustment if the front tires rub against the frame, suspension, body, or the steering gear has been serviced or replaced. Use an alignment machine to check the wheel turn angle. See the measurement procedure of the alignment machine manufacturer.

The steering stop bolt on the steering knuckle controls the maximum turn angle. If the stop bolt is missing, bent, or broken; replace the stop bolt(s) or jam nut(s) and follow the procedure below for adjustment. Inspect other suspension components for damage.

⚠ CAUTION

In power steering systems, the hydraulic pressure should relieve or "drop off" when the steered wheels approach the steering stops in either direction. If the pressure does not relieve, the components of the front suspension may be damaged.

If the steering stop bolts are adjusted to reduce wheel turn angle, the steering gear poppet valves will require readjustment. If the poppets are not re-adjusted properly, then the steering gear will not reduce power assist properly and steering components will be damaged. Refer to TRW's TAS Steering Gear Service Manual for readjusting the poppets.

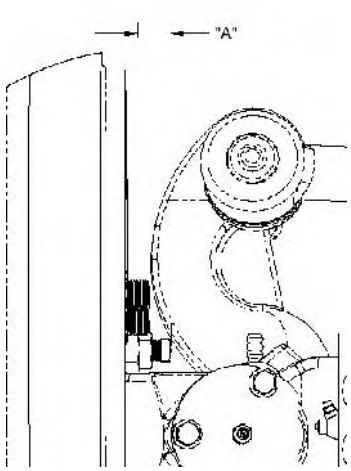


Figure 12 - Steering Stop Bolt

Unit	Steering Stop Length "A"
IFS1700S	1.38"

1. Drive the front tires on a suitable device that allows the front wheels to turn and measures the wheel turn angle.
2. Secure the vehicle by setting the parking brake and block the drive wheels to prevent vehicle movement.

NOTE

Unequal toe-in side to side or an out-of-center steering gear can result in unequal turn angles and steering pull while steering straight ahead. The Crank Rod length may be adjusted to attain steering gear on center condition while maintaining equal toe-in side to side. Do not adjust the length of the Crank Rod or Tie Rods to center the steering wheel. This can cause the steering gear to become off center.

3. Check that the steering gear is centered and the tires are steered straight ahead with equal toe-in side to side. If either of these two conditions is not met, then adjust toe-in first before centering the steering gear. See Adjusting the Toe-In Section and refer to Spartan chassis service guidelines for centering the steering gear.
4. Check that the lengths of the outer tie rods are equal to each other within 1/8 inch. If not, adjust lengths according to the adjusting the toe-in section before adjusting the steering stops.
5. Turn the steering wheel until the steering stop bolt contacts the knuckle carrier or the steering wheel stops turning. Measure the turn angle of the wheel on the same side as the direction of turn.
6. If the wheel turn angle differs from Spartan chassis guidelines then adjust as follows.
7. Loosen the jam nut on the stop bolt.
8. Turn the stop bolt until the specified wheel turn angle is achieved and the bolt head contacts the knuckle carrier.
9. Tighten the jam nut to **50-75 ft-lb** (See Torque Table).

⚠ CAUTION

After readjusting the steering stop(s) check that the steering poppets are reset properly and that the front tires do not contact the frame, suspension, or body. Also check that other components are not abnormally contacting one another.

10. Repeat checking and adjustment for turning the opposite direction.

Inspection before Alignment

See the General Inspection section and check the following before conducting front wheel alignment measurements.

Wheels and Tires

1. Check that the front tires are inflated to the appropriate pressure based on the tire loading.
2. Check that the front tires are the same size and type.
3. Check that all the Wheel Nuts are tightened to the specified torque of **450-500 ft-lb** (See Torque Table).
4. Check that the wheel and tire assemblies are balanced.

Front Suspension

1. Check that all fasteners are tightened to the specified torque.
2. Check the suspension ride height and adjust as needed to the specified height.
3. Check for worn ball joints, tie rod ends, steering arm assembly bearings, control arm bushings, knuckle carrier bearings, and damaged suspension components. Replace worn components as needed.
4. Check for loose ball joint and tie rod end tapered connections, tie rod end jam nuts, steering arm assembly mounts, and chassis steering system components. Inspect connections for wear and replace as needed. Tighten connections as needed.
5. Check the wheel bearing adjustment and adjust as needed.
6. Inspect the shock absorbers for wear and damage.

Rear Axle and Suspension

Front tire wear and incorrect steering can be caused by the rear axle and/or suspension.

1. Check that all fasteners are tightened to the specified torque.
2. Check the suspension ride height and adjust as needed to specified height.
3. Check that all connection joints between the suspension and axle are secure.
4. Check for worn suspension bushings or damaged suspension components.
5. Check that the rear axle is correctly aligned.
6. Check that the frame is not bent.
7. Refer to any additional recommendations and specifications from the manufacturer of the chassis on rear axles and suspensions.

NOTE

Total vehicle alignment is recommended when aligning the front suspension.

Front Wheel Alignment

Equipment

ReycoGranning® recommends that suitable alignment equipment be used to measure the wheel alignment characteristics: camber, caster, and toe-in. The alignment equipment must be properly calibrated for accurate measurements. Only qualified personnel should conduct the wheel alignment measurements.

General

The overall toe-in of the front wheels should be checked every 24,000 miles or 2 years. When the vehicle does not steer correctly or the front tires develop an abnormal tire wear pattern, the camber, caster, and toe-in should be measured and adjusted as needed. Toe-in typically has the largest effect on tire wear.

The maximum wheel turn angle should be checked and adjusted as needed.

Eccentric adapters are installed in the lower control arm mounts. The purpose of the adapters is to provide additional adjustment of camber and caster to minimize vehicle drifts or pulls to one side of the road.

The bar pins of the knuckle carrier bearing marked with a "B" may also be used to provide additional camber adjustment.

Preparation

1. Follow the alignment equipment manufacturer's procedures for preparing the vehicle for front and rear wheel alignment measurements.
2. Secure the vehicle by setting the parking brake and block the drive wheels to prevent vehicle movement.

NOTE

An out-of-center steering gear can result in unequal wheel turn angles. The steering gear should remain centered during toe-in adjustment. Do not adjust the length of the Crank Rod or Tie Rods to center the steering wheel. This can cause the steering gear to become off center.

3. Check that the steering gear is centered when the tires are steered straight ahead (i.e. equal toe-in side to side). Center the steering gear according to Spartan's guidelines.
4. Measure and record the individual wheel camber, caster, and toe-in of the front suspension. Also measure and record the cross camber cross caster, and overall toe-in.
5. If adjustment to camber and caster is required then follow the steps below. Otherwise, go to the "Adjusting the Toe-In" section to adjust the toe-in as needed.

⚠ WARNING

Never work under a vehicle supported by only a jack(s). Jacks can slip or fall over and cause serious personal injury. Always use safety stands. Do not place jacks or safety stands under the lower control arms to support the vehicle. Lower control arms are not stationary components and could move allowing the vehicle drop causing serious personal injury.

6. Raise the vehicle until the front wheels are off the ground. Support the raised vehicle with safety stands.

Adjusting the Camber Angle

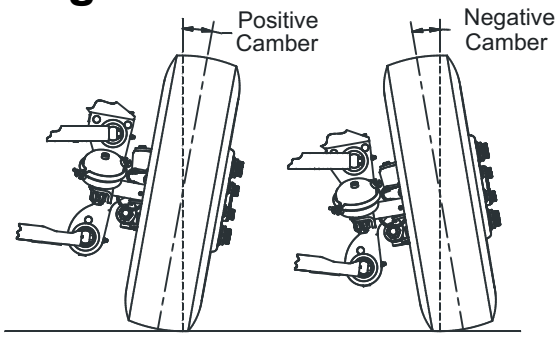


Figure 13 – Camber Angle

⚠ CAUTION

Do not alter components to adjust the camber.

Camber is the angle of the wheel with respect to the ground as viewed from the front or rear of the vehicle (**Figure 13**). Camber is positive when the distance between centers of the front wheels at the top is greater than the distance at the ground.

Wheel Camber Angle is affected by the ride height of the suspension. If the ride height is set too high, then the camber measurement will be more positive. See the inspecting and adjusting suspension ride height sections before measuring camber. The table below lists the recommended camber angles.

Nominal Camber Values-Degrees		
	Unloaded	Loaded
Left	+1/4°(±1/4°)	+1/4°(±1/4°)
Right	+1/4°(±1/4°)	+1/4°(±1/4°)

Eccentric Camber Adjustment

The setscrew in the eccentric adapter denotes the orientation of the eccentricity of the adapter. When the setscrew is in the 12 o'clock position, then the adapter is in the "neutral" position. There are two adapters at each lower control arm mount and they must be oriented the same.

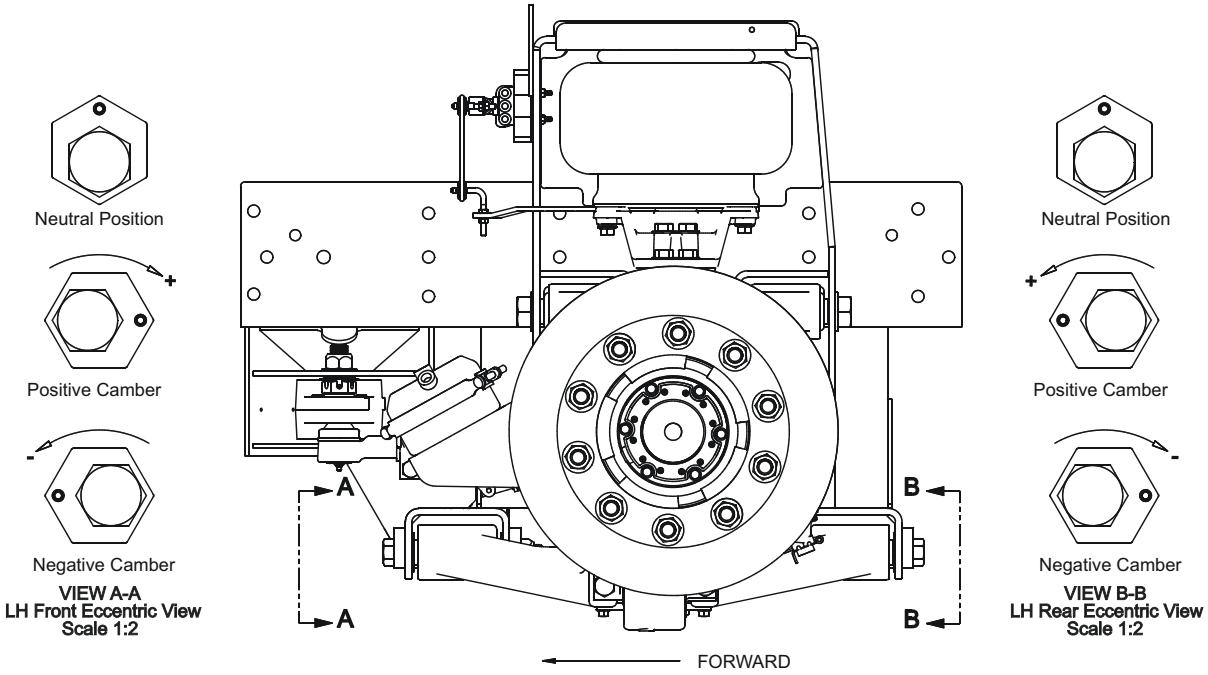


Figure 14 – Eccentric Camber Adjustment

When the setscrews in both lower control arm mounts are oriented closer to the suspension centerline, the tire camber becomes more negative. When the setscrews in both control arm mounts are oriented farther from the suspension centerline, the tire camber becomes more positive (**Figure 14**). The eccentric adapters at both lower control arm mounts must be oriented the same to affect only camber.

1. Loosen both lower control arm mounting bolts at the eccentric adapters. Do not remove the bolts because the adapters must remain engaged in control arm mounting plate for adjustment.
2. Loosen the setscrews.
3. Rotate each eccentric adapter to the same orientation as needed based on measured wheel camber. The eccentric adapters at each control arm mount must have the same orientation.
4. Tighten the adapter locknuts to **465-485 ft-lb** (See Torque Table).
5. Tighten the setscrews to **30-40 ft-lb** (See Torque Table).
6. Remove the jack stands and lower vehicle completely. Check that the suspension is at the proper ride height.
7. Re-measure the camber and readjust as needed.

Bar Pin Camber Adjustment

The lower bar pin of the knuckle carrier bearing marked with a “B” on the end is configured such that it can be re-oriented to provide camber adjustment. Lower bar pins are factory installed with the “B” located closest to the lower control arm. The wheel camber becomes more positive when the lower bar pin is re-oriented such that the “B” is located farthest from the lower control arm.

1. Place a portable jack under the tire to secure and support it.

⚠ CAUTION

Do not remove both upper and lower knuckle carrier mounting bolts at the same time. The knuckle carrier must be secured and supported properly if both upper and lower mounting bolts are removed.

NOTE

Lower control arm may move downward due to the internal gas charge in the shock absorber. A portable jack may be needed to align the lower control arm with the knuckle carrier bar pin.

2. Remove the bottom knuckle carrier mounting bolts from the lower control arm. Heat may need to be applied to the control arm to loosen the thread adhesive. The control arm temperature must not exceed 300°F. Do not apply heat directly to the bar pin or mounting bolts.
3. Raise the jack to separate the bar pin from the control arm and re-orient it.
4. Lower the jack to align the bar pin with the control arm. Apply Loctite #271 to mounting bolt threads and tighten to **350-370 ft-lb** (See Torque Table).

Adjusting the Caster Angle

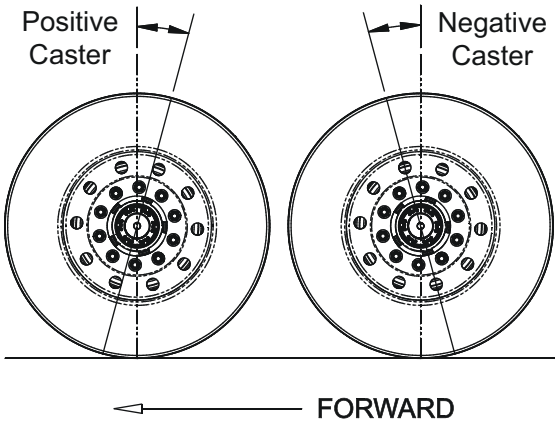


Figure 15 – Caster Angle

⚠ CAUTION

Do not adjust the suspension ride height or alter components to adjust the caster.

The caster angle is the angle between a vertical axis and the axis defined by the king pin when viewed from the side of the vehicle. When the king pin axis appears rotated clockwise relative to the vertical axis, then the caster is positive. Positive caster creates a self-aligning moment to stabilize the vehicle when driving straight ahead (**Figure 15**).

The caster angle is indirectly measured from the change in wheel camber as the wheel is turned through a prescribed turn angle. Therefore, the calculated caster is affected by the ride height of the suspension. See the inspecting and adjusting suspension ride height sections before measuring caster. The table below lists the recommended caster angles.

Nominal Caster Values-Degrees		
	Unloaded	Loaded
Left	+3°(±1/2°)	+3°(±1/2°)
Right	+3°(±1/2°)	+3°(±1/2°)

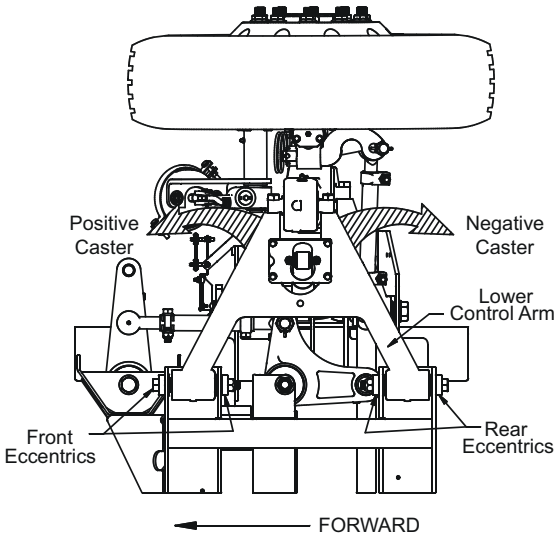


Figure 16 – Lower Control Arm Movement

Eccentric Caster Adjustment

The setscrew in the eccentric adapter denotes the orientation of the eccentricity of the adapter. When the setscrew is in the 12 o'clock position, then the adapter is in the "neutral" position. There are two adapters at each lower control arm mount and they must be oriented the same.

When the setscrews in the forward lower control arm mount are oriented closer to the frame rail and the setscrews in the rearward lower control arm mount are oriented farther from the frame rail, the caster becomes more negative (**Figure 17**).

When the setscrews in the forward lower control arm mount are oriented farther from the frame rail and the setscrews in the rearward control arm mount are oriented closer to the frame rail, the caster becomes more positive.

The eccentric adapters at both lower control arm mounts must be oriented opposite each other to affect caster.

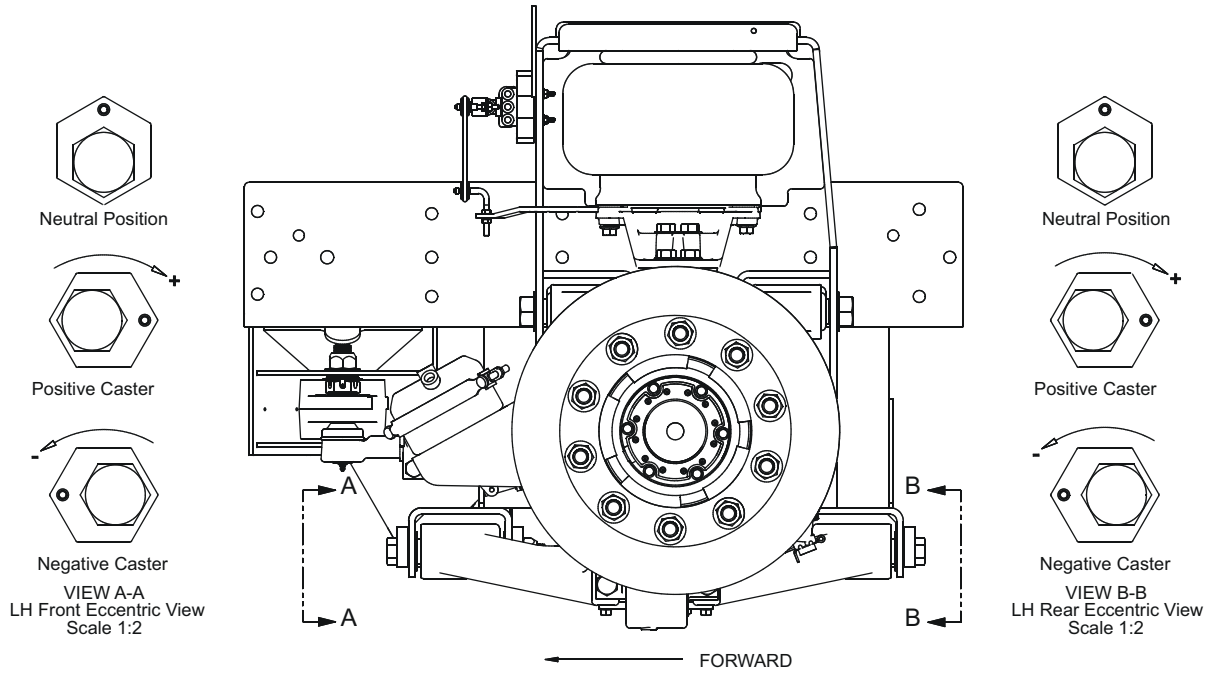


Figure 17 – Eccentric Caster Adjustment

1. Loosen both lower control arm mounting bolts at the eccentric adapters. Do not remove the bolts because the adapters must remain engaged in control arm mounting plate for adjustment.
2. Loosen the setscrews.
3. Rotate the eccentric adapters at the forward and rearward control arm mounts opposite one another as needed based on measured wheel caster. The eccentric adapters at each control arm mount must have the same orientation.
4. Tighten the adapter locknuts to **465-485 ft-lb** (See Torque Table).
5. Tighten the setscrews to **30-40 in-lb** (See Torque Table).
6. Remove the jack stands and lower vehicle completely. Check that the suspension is at the proper ride height.
7. Re-measure caster and readjust as needed.

Adjusting the Toe-In

CAUTION

Do not alter components to adjust the toe-in.

CAUTION

Improperly oriented tie rod clamps can cause binding in the suspension steering system.

Wheel toe-in is the relationship of the distance between the centers of the front and rear of the front wheels. When the front distance is less than the rear distance, the wheels are “toed-in”. Toe-in is designed into the suspension to counteract the tendency of the tires to toe-out when the vehicle is driven straight ahead. Incorrect toe-in can result in rapid tire wear.

1. Measure the length of the outer tie rods. Reference length is 17 inches.
2. If the lengths of the outer tie rods are not within 1/8 inch of each other, then adjust their lengths such that they are within 1/8 inch of each other. Loosen the tie rod clamps on each end of the tie rod and turn the center tube to change the length.
3. Adjust the length of both outer tie rods equally such that the toe-in on each side is 1/16" ± 1/32" and the overall toe-in is 1/8" ± 1/16". Tighten tie rod clamp nuts to **50-60 ft-lb** (See Torque Table). Refer to **Figure 6** for tie rod clamp orientation.

General Procedures

Repair or reconditioning of front suspension components is not allowed. Components that are damaged or worn must be replaced. Several major components are heat treated and tempered.

⚠ WARNING

The components cannot be bent, welded, heated altered, or repaired in any way without reducing the strength or life of the component and voiding the warranty.

The following operations are prohibited on front suspension components.

1. Welding of or to the steering knuckles, control arms, steering arm assemblies, knuckle carrier, tie rod assemblies, the brakes, the hubs, and the brake rotors.
2. Hot or cold bending of the steering knuckles, control arms, steering arm assemblies, knuckle carrier, tie rod assemblies, ball joints, and the sub-frame except control arm and steering arm assembly mounts which may be cold bent to facilitate bushing and bearing replacement.
3. Drilling out control arm and steering arm assembly mounting holes and ball stud tapered holes.
4. Spray welding of bearing diameters on the steering knuckle spindle, steering arm assembly bores and pivot tube. Spray welding of ball studs or tapered holes for the ball joint and tie rod ends.
5. Milling or machining of any component except that control arm bushing bores may be honed to remove any burrs.

⚠ WARNING

Never work under a vehicle supported by only a jack(s). Jacks can slip or fall over and cause serious personal injury. Always use safety stands. Do not place jacks or safety stands under the lower control arms to support the vehicle. Lower control arms are not stationary components and could move allowing the vehicle drop causing serious personal injury.

The vehicle may be supported on safety stands by the suspension sub-frame or chassis frame for repairs that require removal of the wheel and tires or deflation of the air springs. Always secure the vehicle by setting the parking brake and block the drive wheels to prevent vehicle movement before performing repairs.

Cleaning the Parts

⚠ WARNING

If you use cleaning solvents, hot solution tanks or alkaline solutions incorrectly, serious personal injury can occur. To prevent injury, follow the instructions supplied by the manufacturer. Do NOT use gasoline to clean parts. Gasoline can explode.

Ground or Polished Parts

Use a cleaning solvent to clean ground or polished parts and surfaces. DO NOT clean ground or polished parts with hot solution tank or with water, steam or alkaline solutions. These solutions will cause corrosion of the parts.

Rough Parts

Rough parts can be cleaned with the ground and polished parts. Rough parts also can be cleaned in hot solution tanks with a weak alkaline solution. Parts should remain in the hot solution tanks until they are completely cleaned.

Drying

Parts must be dried immediately after cleaning. Dry all parts with clean paper or rags, or compressed air. Do not dry bearings by spinning with compressed air.

Preventing Corrosion

Apply light oil to cleaned and dried parts that are not damaged and are to be immediately assembled. Do NOT apply oil to the brake pads or the brake rotors. If the parts are to be stored, apply a good corrosion preventative to all surfaces and place them inside special paper or containers that prevent corrosion. Do NOT apply corrosion preventative to the brake pads or the brake rotors.

Replacing Tie Rod Ends

Removal

1. Remove the cotter pins from the tie rod end ball stud(s).
2. Remove the castle nuts from the tie rod end ball stud(s).

⚠ CAUTION

Do not strike the component mating taper directly with a steel hammer. Parts can break and cause serious personal injury. Wear eye protection.

3. Disconnect the tie rod end ball stud from the mating component tapered hole using a suitable tool.
4. Inspect the tie rod end ball stud and mating component tapered hole(s). Replace components with worn tapered hole(s). If the grease seal is damaged during removal, replace it before installation.

Installation

1. Clean the mating component tapered hole(s) of any contamination. Insert the tie rod end ball stud into the tapered hole and secure it with the castle nut.

⚠ CAUTION

Tighten the castle nuts to the specified torque. If the castle nuts are not tightened to the specified torque, the parts will be damaged and serious personal injury may occur.

2. Tighten the castle nut to **90-100 ft-lb** (See Torque Table).
3. Install the cotter pins. If necessary, tighten the castle nut to align the hole in the ball stud and slots in the castle nut. Do not loosen the castle nut to install the cotter pin.
4. Lubricate tie rod end as needed.

Replacing the Relay Rod Ball Joints

The thread-in mount type ball joints are installed with a thread adhesive and may require the threads to be warmed to ease removal. If heat is applied to the ball joint threads, the steering arm assembly temperature must not exceed 300°F and the heat should be applied at the bottom of the ball joint base only. Applying heat to the ball joint will damage the ball joint by destroying its internal components as well as the external seal permanently, degrading the lubricant, and restricting ball stud movement.

It is recommended that the appropriate tools be used to remove the ball stud taper from the Relay Rod and to remove the ball joint base from the steering arm assembly.

Removal

1. Remove the cotter pins from the ball joint ball stud(s).
2. Remove the castle nuts from the ball joint ball stud(s).

⚠ CAUTION

Do not strike the component mating taper directly with a steel hammer. Parts can break and cause serious personal injury. Wear eye protection.

3. Disconnect the ball joint ball stud from the Relay Rod tapered hole using a suitable tool.
4. Secure the steering arm assembly and remove the ball joint using a ball joint spanner wrench or similar device on the base. Steering arm assembly may be removed to facilitate ball joint removal. See the steering arm assembly replacement section as needed.
5. Inspect the ball joint stud and Relay Rod tapered hole(s). Replace Relay Rod if tapered hole(s) is worn.

Installation

1. Clean the threaded hole in steering arm assembly of any contamination.
2. Apply thread adhesive Loctite #242 to the ball joint base threads and thread it into the steering arm assembly by hand.
3. Tighten the base of the ball joint to **325-375 ft-lb** (See Torque Table).
4. Clean the Relay Rod tapered hole(s) of any contamination. Insert the ball joint stud into the tapered hole and secure it with the castle nut.

⚠ CAUTION

Tighten the castle nuts to the specified torque. If the castle nuts are not tightened to the specified torque, the parts will be damaged and serious personal injury may occur.

5. Tighten the castle nut to **155-175 ft-lb** (See Torque Table).
6. Install the cotter pins. If necessary, tighten the castle nut to align the hole in the ball stud and slots in the castle nut. Do not loosen the castle nut to install the cotter pin.

Replacing the Bell Crank, Idler Arm, and Crank Arm Bearings

Replace the bell crank, idler, and crank steering arm bearings in sets. The replacement bearings should be installed by pressing on the outer raceway only. Pressing on the inner raceway will damage the bearing.

The inner grease cavity of the steering arm assemblies should be cleaned when the bearings are replaced.

Removal

1. Follow the procedures for removal of the Relay Rod from the ball joint in the bell crank and idler arm.
2. Follow the procedures for removal of tie rod ends for the crank arm.
3. Remove the pivot bolts that mount the idler arm and bell crank. Remove them from the sub-frame.
4. Remove the retaining rings from the pivot sleeve and remove the sleeve. A rubber or brass hammer may be used to remove the sleeve. Retain shims.
5. Support the steering arm assembly bearing housing and press the bearing out of each end.

Installation

1. Clean out the steering arm assembly grease cavity.
2. Inspect steering arm assembly bearing housing bores and remove burrs by honing. Replace steering arm assembly if the bore is damaged.
3. Pack the steering arm assembly bearing with grease.
4. Support the steering arm assembly bearing housing and press the bearing into each end. The seal side of the bearing should face out.
5. Inspect the pivot sleeve and remove burrs with emery cloth.
6. Install one retaining ring onto pivot sleeve.
7. Insert the pivot sleeve into the lower bearing. Use a rubber mallet or similar tool to drive the inner sleeve into the bearings such that the bottom-retaining ring is seated against the bottom inner race. Do not use a steel hammer to install the sleeve because bearing raceways can be damaged.
8. Install upper retaining ring. Reseat lower retaining ring against the lower inner race as needed.
9. Determine the number of shims needed by stacking the shims and placing the stack between the upper retaining ring and inner race until a snug fit is achieved. Remove one shim from the stack and this is the number of shims needed. A maximum of six shims may be used.
10. Remove the upper retaining ring, install the shims determined in step 9 onto the inner sleeve at upper inner race, and re-install the upper retaining ring. Check that upper retaining ring is properly seated in the groove of the inner sleeve.
11. Place the steering arm assembly in its mount and install the pivot bolt. Tighten the pivot bolt lock nut to **575-625 ft-lb** (See Torque Table).
12. Follow the procedures for installation of the Relay Rod or tie rod.

Replacing the Upper and Lower Control Arm Bushings

The sub-frame control arm mounts may require widening to accommodate replacement bushings. A suitable jack may be used to increase the width of the control arm mounts by cold bending. Care must be taken to not exceed 5.00” width after widening. The control arm mounts should be inspected for damage.

Both control arm bushings and mounting hardware except eccentric adapters must

be replaced in a control arm when bushings are serviced. It is recommended to replace the control arm bushings and mounting fasteners in all of the control arms at the same time.

The control arm housings must be properly supported during bushing removal. The bores of the control arm housings may be honed to remove any burrs.

⚠CAUTION

Use of a cutting torch to remove control arm bolts will permanently damage control arm bushings and can result in damage to sub-frame.

It is recommended that the wheel and tire be removed to provide proper accessibility. Disconnect the vertical height control valve linkage from the horizontal arm to prevent unintentional inflation of the air spring.

Upper Control Arm Removal

1. Place a portable jack under the knuckle carrier to secure and support it.

⚠CAUTION

Do not remove both upper and lower knuckle carrier mounting bolts at the same time unless the knuckle carrier is properly secured.

2. Remove knuckle carrier mounting bolts from the control arm. Heat may need to be applied to the control arm to loosen the thread adhesive. The control arm temperature must not exceed 300°F. Do not apply heat directly to the bar pin or mounting bolts.
3. Disconnect sway bar connector at sway bar if so equipped with a sway bar.
4. Loosen and remove control arm mounting locknuts.
5. Support control arm and remove control arm mounting bolts. Remove the control arm.
6. Remove the sway bar bracket and linkage from the control arm and retain for installation.
7. Press the bushings out of the housings. Support the housing properly.

Upper Control Arm Installation

1. Inspect the housing bores and remove any burrs in the housing bores by honing.
2. Press the bushings into the housings using a suitable tool to apply pressure to only the outer metal of the bushing. Support the housing properly.
3. Re-install the sway bar bracket and linkage if removed.
4. Place the control arm in its mount location. Install the control arm mounting hardware and tighten snugly.
5. Orient the control arm at suspension ride height and tighten the bolts to **950-1050 ft-lb** (See Torque Table).
6. Reconnect the sway bar linkage. Tighten mounting bolt to **75-85 ft-lb** (See Torque Table).
7. Apply Loctite #271 to mounting bolt threads and tighten to **350-370 ft-lb** (See Torque Table).

Lower Control Arm Removal

1. Place a portable jack under the knuckle carrier to secure and support it.

⚠ CAUTION

Do not remove both upper and lower knuckle carrier mounting bolts at the same time unless the knuckle carrier is properly secured.

NOTE

Lower control arm may move downward due to the internal gas charge in the shock absorber. A portable jack may be needed to align the lower control arm with the knuckle carrier bar pin.

2. Remove knuckle carrier mounting bolts from the control arm. Heat may need to be applied to the control arm to loosen the thread adhesive. The control arm temperature must not exceed 300°F. Do not apply heat directly to the bar pin or mounting bolts.
3. Note orientation of lower bar pin in carrier bearing. Raise the jack as needed to separate the bar pin from the control arm.
4. Remove and retain the lower shock bar pin mounting hardware. Shock will extend due to internal gas charge. Rotate bar pin to provide clearance with mounting bracket.
5. Note orientation of eccentric adapters for installation.
6. Loosen and remove control arm mounting locknuts.
7. Support control arm and remove control arm mounting bolts. Retain eccentric adapters for installation. Remove the control arm.
8. Remove spacer tubes from bushings and retain for installation.
9. Press the bushings out of the housings. Support the housing properly.

Lower Control Arm Installation

1. Inspect the housing bores and remove any burrs in the housing bores by honing.
2. Press the bushings into the housings using a suitable tool to apply pressure to only the outer metal of the bushing. Support the housing properly.
3. Install the spacer tubes in bushings.
4. Place the control arm in its mount location. Install the control arm eccentric adapters and mounting hardware and tighten snugly. Orient the eccentric adapters the same as before removal.
5. Orient the control arm at suspension ride height and tighten the bolts to **465-485 ft-lb** (See Torque Table).
6. Note orientation of bar pin in carrier bearing. Lower the jack to align the bar pin with the control arm.
7. Apply Loctite #271 to mounting bolt threads and tighten to **350-370 ft-lb** (See Torque Table).
8. Compress shock absorber and connect the lower control arm to the lower shock bracket using the mounting hardware. Tighten the nuts to **30-40 ft-lb** (See Torque Table).

Replacing Wheel Bearings, Oil Seals, and Hub Caps

If the Wheel Nuts have chrome covers, remove them with special pliers equipped with plastic non-marring jaws. Place them in a container to prevent damage or loss.

On aluminum wheels, place a plastic anti-scuff guard over the Wheel Nuts and loosen the Wheel Nuts. On steel wheels, remove the wheel hub cap nuts if present and the wheel hub cap before loosening the Wheel Nuts. Place the wheel hub cap in safe location to prevent damage. Place the wheel and/or wheel hub cap nuts in a container to prevent contamination or loss.

Remove the wheel and tire assembly and place it aside. Mark the tire to ensure it can be identified for installation on same side as removed. Remove the brake rotor assembly and place it aside. Mark the rotor assembly to ensure it can be identified for installation on same side as removed.

Removal

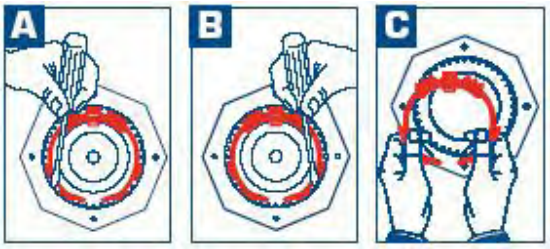
1. Place an oil drip tub beneath the hub to catch oil. Rotate the hub such that the hub cap drain plug is facing upwards. Remove the drain plug from the hub cap and place it in a container for re-installation.
2. Rotate the hub such that the drain hole faces downward and drain the oil from hub cavity. Wait a few minutes for most of the oil to drain before continuing to the next step.
3. Remove the Brake Caliper.
4. Remove the hub cap bolts, hub cap, and gasket. Take care not to damage the gasket for re-installation. Place the components in a location to prevent contamination.

NOTE: Hub cap window may be damaged by solvents.

NOTE

When removing or installing the outer spindle nut, use the correct wrench sockets to avoid damaging the nuts. Do not use impact driver to tighten outer nut. Only use a torque wrench to tighten the nuts.

5. Remove the keeper from the nut.



6. A, B, C Use a small screwdriver to carefully pry the keeper arm from the undercut groove on each side until the keeper is released.
7. Remove the retaining nut
8. Tug sharply on the hub to unseat the outer bearing without completely removing the hub. Wipe up any oil spilled on the brake assembly as quickly and completely as possible. Remove the outer bearing and place it in a container to prevent contamination.
9. Remove the hub from the spindle and place it on the floor with its stud side facing downwards. Protect the wheel studs from damage. Wipe the excess oil off spindle with a clean shop towel to prevent oil dripping onto the brake assembly.
10. Remove the hub seal and discard it. Remove the wear ring from the spindle and discard it.

11. Inspect the inner cup (outer bearing race for the inner bearing) and outer cup in the hub for damage. Replace the bearing cups if worn or damaged.
12. Inspect the bearing areas on the spindle for wear or damage. Burrs may be removed by light application of emery cloth. Replace steering knuckle if the spindle is damaged.

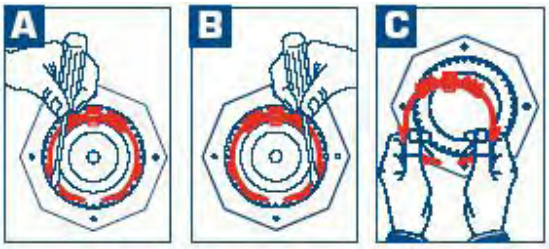
Installation

1. Place the hub seal assembly with axle ring onto the spindle so the words “Oil Bearing Side” face outboard. Do not place the seal in the hub bore.
2. Drive the seal onto the spindle using the appropriate seal installation tool and a 3-5lb hammer. (Reference Stemco P/N 0155220) The wear ring is fully seated when it is square and flush with the face of the inner bearing shoulder of the spindle. Reseat the seal onto the wear ring if it becomes dislodged after seating.

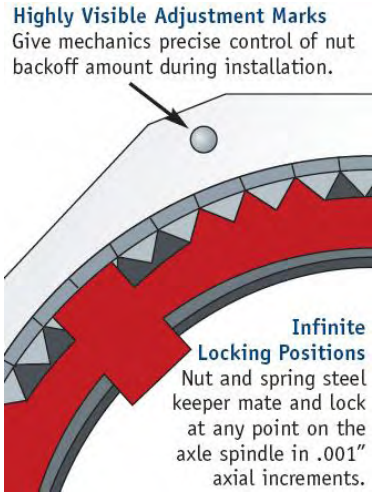
NOTE

Do not drive bearings onto the spindle with a steel hammer or similar instrument. Bearing inner race is a tight slip fit with spindle.

3. Pre-lube the inner bearing and place it onto spindle with small end of taper facing outward. Seat the inner race against the shoulder of the spindle.
4. Press the ABS sensor outward about ¼”. Do not use a sharp tool on lead wire end of the sensor. See section for the inspection of ABS sensor as needed.
5. Place the hub onto the spindle until it seats on the inner bearing. Do not “ram” the hub onto the seal.
6. Pre-lubed outer bearing and place it onto the spindle until it seats on the outer cup in the hub. The bearing retaining washer may be used to guide the bearing onto the spindle. The hub should be supported to prevent misalignment and binding.
7. Remove the keeper from the nut.

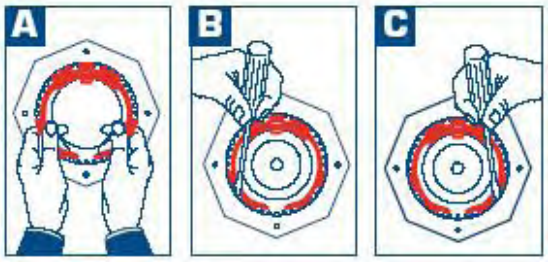


8. A, B, C Use a small screwdriver to carefully pry the keeper arm from the undercut groove on each side until the keeper is released.
9. Seat the bearing, with the hub rotor only, using a torque wrench.
10. Tighten the nut to 200 ft-lb. Spin the wheel at least one full rotation.
11. Repeat step #9 two more times.
12. Back the nut off until it is loose.


Highly Visible Adjustment Marks
Give mechanics precise control of nut backoff amount during installation.
Infinite Locking Positions
Nut and spring steel keeper mate and lock at any point on the axle spindle in .001” axial increments.

13. Adjust the bearing by tightening the nut to 100 ft-lb. Spin the wheel at least one full rotation.
14. Repeat step #12 two more times

15. Back the nut off one raised face mark (1/4 turn)
16. Install the keeper with the orange side facing out.
17. Align the flat of the keeper with the milled flat on the spindle and insert the single keeper tab into the undercut groove of the nut. Install the keeper with the orange side facing out.
18. Engage the mating teeth



19. Compress and insert the keeper arms, one at a time, into the undercut groove with a small screwdriver.
20. Refer to the Wheel Bearing Endplay Adjustment section to measure and adjust the endplay to .001-.005 inch. Adjust by loosening spindle nut, re-indexing the spindle nut accordingly, and repeat Steps 8 thru 19 until proper endplay is achieved.
21. Install hub cap gasket and hub cap. Tighten the cap screws to 20-30 ft-lb (See Torque Table). Replace the hub cap vent plug if removed.
22. Fill the hub cavity with the appropriate amount and type of lubricant and secure drain plug.
23. Check oil level through the hub cap window. (**Figure 18**). If level is below the "add" level line, then fill with recommended oil until "full" level is achieved. Add oil slowly since the heavy weight oil will settle slowly in the hub.

NOTE: The hub cap window can only be cleaned with mild soap and water. Aromatic solvents should not be used, as they will impair the transparency of the window.

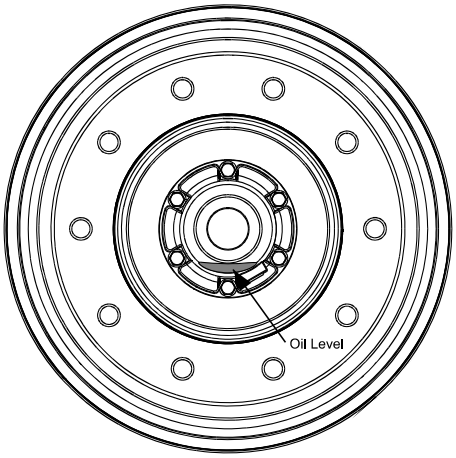


Figure 18 - Wheel Bearing Oil Level

24. Check the hub cap for external oil leakage at the drain plug or gasket. For leaks at the drain plug check for application of thread sealant to threads and tightness. For leaks at the gasket, replace the gasket. The vent plug will normally weep a small amount of oil.
25. Install the Brake Caliper and Pads.
26. Install the wheel and tire assembly and the Wheel Nuts.
27. On aluminum wheels, use a plastic anti-scuff guard over the Wheel Nuts. Tighten the Wheel Nuts in sequence to **450-500 ft-lb** (See Torque Table).
28. Replace the wheel hub cap nuts and hub caps if removed to service the wheel bearings.

Replacing Brake Components

Brake Rotors

The brake rotor should be replaced if they are damaged or exceed the rotor manufacturers recommended minimum thickness or run-out specification. Refer to Brake Rotor manufacturer guidelines for inspection and specifications.

Brake Chambers

The brake air chambers should be replaced if damaged or malfunctioning. Refer to manufacturer guidelines for correct function of the brake air chambers.

Other Brake Components

The brake pads should be replaced when they are worn beyond the manufacturer's limits. Refer to the brake manufacturers guidelines for servicing the brakes.

Replacing the ABS Sensor and Tone Ring

The anti-lock brake system (ABS) of the vehicle should be diagnosed by a qualified technician before the anti-lock brake sensor or the tone ring is replaced. Replacement parts must be equivalent to the vehicle manufacturers to ensure proper function of the anti-lock brake system. The anti-lock brake sensor and tone ring cannot be repaired and must be replaced if damaged or malfunctioning.

Sensor Removal

1. Remove the Brake Caliper to provide access to sensor.
2. Press sensor out of steering knuckle. Do not pull sensor out by its lead wire.
3. Remove tie straps that secure the sensor lead wire and disconnect the sensor lead wire from the chassis wire harness.

Sensor Installation

1. Check that the sensor bushing is properly seated in the steering knuckle and the sensor spring retainer is seated properly in the sensor bushing.
2. Press the sensor into the steering knuckle until the sensor end contacts the tone ring.
3. Connect a volt meter to the connector pins of the sensor lead wire. Set the volt meter to read AC voltage on a scale of 0-10V.
4. Spin the hub by hand and read the voltage output of the sensor. A minimum reading of 0.8V AC is normal. Skip to step 8 if minimum reading is obtained.
5. If the minimum reading is not obtained then check the volt meter connection and proximity of the sensor and tone ring. The air gap between the sensor and tone ring should not exceed .027". Repeat step 4.
6. If the minimum reading is not obtained, check the tone ring for damage and its installation. The tone ring should have a maximum run out of .008". Replace as needed and repeat step 4.
7. If the minimum reading is still not obtained, then replace the sensor and repeat the installation procedure.
8. Route and secure the sensor lead wire the same as the removed sensor.
9. Connect the sensor lead wire to the chassis. Secure wire lead to prevent damage during suspension movement.

Tone Ring Removal and Installation

Follow the hub manufacturer's guidelines for removal and installation of the tone ring.

Replacing the Shock Absorber

⚠ CAUTION

The shock absorber is gas pressurized and must not be punctured or be subjected to excessive heat which can result in serious personal injury. The shock will expand to its full extended length if not restrained.

Removal

1. Remove the lower shock thru bolt mounting hardware and retain for installation. Do not remove the lower shock mount bracket from the lower control arm.
2. Remove upper shock bushing mounting hardware and retain for installation. Note location and quantity of washers and spacers.

Installation

1. Loosely attach upper shock bushing to sub-frame with mounting hardware (spacers on forward side of shock).
2. Position shock in suspension such that the thru bolt is connected to the lower shock mounting bracket tabs.
3. Tighten lower thru mounting bolt and nut to **170-190 ft-lb (**See Torque Table). Tighten lower shock bracket mounting bolts to **30-40 ft-lb** (See Torque Table).
4. Tighten upper mounting nut to **170-190 ft-lb (**See Torque Table).

Replacing the Air Spring

The correct air spring must be installed. The use of a substitute air spring is not allowed and may cause unequal load sharing between the air springs and cause adverse ride and handling characteristics.

Removal

1. Deflate the air spring by disconnecting one end of the vertical HCV linkage from the horizontal arm. Rotate the horizontal HCV arm downward and secure it in place.
2. Disconnect the airline at the air spring inlet port and remove the connection fitting from the inlet port.
3. Remove the bolts and washers from the upper air spring mount studs. Note location of bolts and washers.
4. Remove the bolts that secure the air spring to the lower air spring mount.

Installation

1. Attach air spring to upper air spring mount. Note that the shorter bolt is located towards the front. Tighten mounting hardware snugly.
2. Attach air spring to lower air spring mount. Tighten lower mounting bolts to **20-30 ft-lb** (See Torque Table).
3. Tighten the upper mounting bolts to **15-20 ft-lb** (See Torque Table).
4. Apply Permatex or equivalent thread sealant to the threads of the air connection fitting and install the fitting.
5. Connect the airline to the fitting.
6. Inflate the air spring by un-securing the HCV horizontal arm and reconnecting the vertical linkage to it.

7. Check the airline and fitting for air leaks.

Replacing the Height Control Valve

The correct height control valve (HCV) must be installed. The use of a substitute HCV is not allowed and may cause unequal load sharing between the air springs and cause adverse ride and handling characteristics.

Removal

1. Drain the air from the supply reservoir on the chassis connected to the front suspension.
2. Disconnect the vertical HCV linkage from the horizontal arm.
3. Mark airlines and connections for re-assembly. Disconnect the airlines from the HCV. If any other plumbing fixtures are connected to the HCV, mark them for re-assembly.
4. Remove the HCV mounting hardware from the sub-frame.
5. Remove any other air fittings or plumbing fixtures from the HCV.

Installation

1. Apply Permatex or equivalent thread sealant to the threads of the air connection fittings or plumbing fixtures and install the fittings or plumbing fixtures in the HCV.
2. Attach the HCV to the sub-frame with mounting hardware. Orient the horizontal arm horizontally and tighten the mounting nuts to **7-9 ft-lb** (See Torque Table).
3. Connect airlines as marked during removal.
4. Connect the vertical linkage to the horizontal arm.
5. Recharge system with air and check for air leaks.
6. Check the ride height and adjust per section on adjusting the ride height as needed.

Replacing the Sway Bar and Components

It is recommended that the sway bar mounting bushings and the vertical linkages be replaced all at the same time.

Vertical Linkage Removal

1. Disconnect sway vertical linkage at upper control arm bracket on both sides. Retain hardware for installation.
2. Secure the sway bar to prevent rotation and disconnect the lower connection to the sway bar on both sides.

Vertical Linkage Installation

1. Attach the sway bar vertical linkage to the upper and lower mounts.
2. Tighten the mounting nuts to **75-85 ft-lb** (See Torque Table).

Sway Bar Removal

1. Follow the instructions for removal of the sway bar vertical linkage for both sides.
2. Remove mounting hardware from “D” ring sway bar mounts on rear of suspension sub-frame. Retain hardware for installation.
3. Remove the “D” rings and bushings from the sway bar.

Sway Bar Installation

1. Replace the “D” ring bushings.

2. Apply TC 1920 Aqua Shield Grease to the inside of the bushing. Attach the "D" rings and bushings to the sway bar in the same location as removal.
3. Attach the sway bar to the sub-frame using the mounting hardware.
4. Tighten the mounting nuts to **50-55 ft-lb** (See Torque Table).
5. Follow the instructions for installation of the sway bar vertical linkage for both sides.

Replacing the Steering Knuckle Carrier Bearings

It is recommended to replace all the steering knuckle carrier bearings at the same time.

The wheel and tire should be removed to provide access. The steering knuckle may be removed to provide easier handling of steering knuckle carrier assembly.

⚠ CAUTION

The knuckle carrier must be secured and supported properly when upper and lower mounting bolts are removed.

NOTE

Lower control arm may move downward due to the internal gas charge in the shock absorber. A portable jack may be needed to align the lower control arm with the knuckle carrier bar pin.

Removal

1. Note installed orientation of the upper and lower bar pin. Lower bar pins are factory installed with the "B" located closest to the lower control arm.
2. Remove the steering knuckle carrier mounting bolts from the upper and lower control arms. Heat may need to be applied to the control arm to loosen the thread adhesive. The control arm temperature must not exceed 300°F. Do not apply heat directly to the bar pin or mounting bolts.
3. Remove steering knuckle carrier.
4. Support fixed shoulder end of the bar pin.
5. Remove retaining clip and outer collar from the split ring.
6. Apply approximately 400 lbs press load to the spacer and remove the split collar.

⚠ CAUTION

Do not apply excessive preload to bearings.

7. Remove spacer and shims.
8. Press bar pin out of bearing cones.
9. Remove outer seals from both sides of bearings.
10. Remove bearing raceways from the steering knuckle carrier. Do not damage bores.
11. Clean the remaining grease from the bearing cavity.

Installation

1. Inspect bearing raceway and seal bores in steering knuckle carrier for burrs or damage. Inspect the bar pin for burrs or damage. Remove burrs and replace damaged components.
2. Press a bearing race into each steering knuckle carrier bore until fully seated.
3. Pack a bearing cone with grease and place it onto the bar pin and seat the inner race on the shoulder.
4. Note the position and orientation of bar pin relative to the carrier. The shoulder end of the bar pin faces forward on the upper bar pin location. The shoulder end of the bar pin faces rearward on the lower bar pin location.
5. Insert the bar pin into the steering knuckle carrier until the bearing cone is seated in the raceway.
6. Turn the steering knuckle carrier over and support the shoulder end of the bar pin.
7. Pack a bearing cone with grease and place it onto the bar pin end opposite the shoulder and seat it in the raceway.
8. Place the spacer onto the bar pin and seat it against the inner raceway.
9. Apply approximately 400 lbs of press load to the spacer. Place the split collar into the groove of the bar pin and against the spacer.
10. Use a “feeler” gage to measure the gap between the split collar and shoulder of the groove in the bar pin. Record measurement.
11. Remove the load. Then remove the split collar and spacer.
12. Using the gap measurement from Step 10, place a number of shims equivalent to the gap measurement onto the bar pin against the inner raceway.
13. Place the spacer onto the bar pin.
14. Apply approximately 400 lbs of press load to the spacer such that the split collar can be inserted into the groove of the bar pin. Make sure the split collar is fully seated in the groove.
15. Remove the press load.
16. Place the outer collar around the split collar. Install the retaining clip around the split collar on the outside of the outside collar.
17. Press a seal into each seal bore until fully seated.
18. Check bearing preload by rotating the bar pin. Slight to medium drag should be felt. If too loose, add one shim. If too tight, remove one shim.
19. Fill bearing cavity with grease.
20. Install steering knuckle carrier mounting bolts in control arms. Note orientation of bar pin. Apply Loctite #271 to mounting bolt threads and tighten to **350-370 ft-lb** (See Torque Table).

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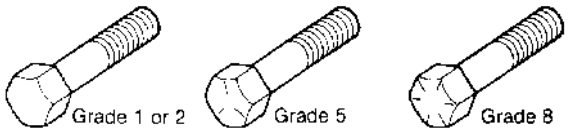
Torque Tables

Most threaded fasteners are covered by specifications that define required mechanical properties, such as tensile strength, yield strength, proof load, and hardness. These specifications are carefully considered in initial selection of fasteners for a given application. To assure continued satisfactory vehicle performance, replacement fasteners used should be of the correct strength, as well as the correct nominal diameter, thread pitch, length, and finish.



Grade Markings on Bolts

Grade	Lock Nut Grade B, F	Lock Nut: Grade C, G
Identification	3 Dots	6 Dots

Grade Markings on Lock Nuts

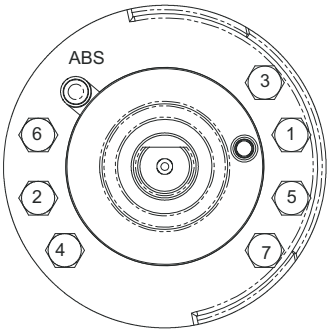
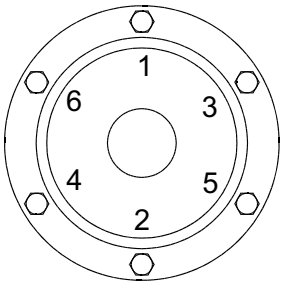
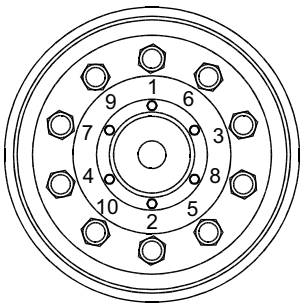
Torque Table 1

APPLICATIONS	FASTENER SIZE	TORQUE SPECIFICATION (ft-lb) (CLEAN AND DRY)
Upper Control Arm Bushing Pivot Bolt	1 1/8-12 x 7¾ Gr 8	950-1050(1)
Lower Control Arm Bushing Pivot Bolt	7/8-9 x 8½ Gr 8	465-485(1)
Eccentric Setscrew	#10-24 x 3/8	30-40 (**in-lb**)
Steering Knuckle Carrier Mounting Bolt	3/4-10 x 2¾ Gr 8	350-370(1,4)
Lower Air Spring Mount Bolt (into Carrier)	5/8-18 x 3 Gr 8 5/8-18 x 1¾ Gr 8	170-190(1,4)
Air Spring Upper Mount Bolt (thru Cradle)	3/8-16 x 1 Gr 8	15-20(1)
Air Spring Lower Mount Bolt (into Air Spring)	1/2-13 x 1¾ Gr 8	20-30(1)
Idler Arm, Bell Crank & Crank Arm Mount Bolt	1-14 x 6 Gr 8	575-625(1)
Idler Arm & Bell Crank Ball Joint Base	M56-1.5	325-375(2)
Idler Arm & Bell Crank Ball Joint Castle Nut	M20-1.5	155-175(3)
Tie Rod Castle Nut	7/8-14	90-100(3)
Tie Rod Clamp Nut	5/8-11 Grade B	50-60
Upper Shock Eye Mount Lock Nut	3/4-10 Grade C	170-190
Lower Shock Eye Mount Lock Nut	3/4-10 Grade C	170-190
Lower Shock Mount Bracket Bolt	3/8-16 x 1¼ Gr 8	30-40(1)
Steering Stop Jam Nut	1/2-20 Grade B	50-75
Steering Arm Assembly Castle Nut	1 1/8-12 Grade C	550-1025(3)
Sway Bar Mounting Bracket Nut	7/16-14 Grade C	50-55
Sway Bar Linkage Nut	1/2-13 Gr 8	75-85
Sway Bar Upper Control Arm Bracket Nut	1/2-13 Gr 8	75-85
Kingpin Draw Key Nut	1/2-20 Grade G	30-45
Kingpin Cap Bolt	5/16-18 x 1 Gr 8	20-30(1)
Height Control Valve Mount Lock Nut	1/4-20 Grade C	7-9
Height Control Valve Linkage Stud Mount Nut	5/16-18 Grade B	8-12
Height Control Valve Adjuster Nut	1/4-20 5/16-18	24-28 (**in-lb**)
Pro-Torq Spindle Nut	1½ -18	See Adjusting Wheel End Play
Disc Brake Caliper Mount Screw	M20-2.5 x 60	325-375

1) Torque applied to bolt head
2) Apply thread adhesive Loctite #242 or equivalent to threads of fastener threaded into tapped hole
3) Install cotter pin after tightening
4) Apply thread adhesive Loctite #271 or equivalent to threads of fastener threaded into tapped hole

Torque Tables

Torque Table 2

APPLICATIONS	FASTENER SIZE	TORQUE SPEC. (ft-lb) (CLEAN AND DRY)	TORQUE SEQUENCE
Torque Plate Mount Cap Screws	3/4-16 Grade 8	290-320	 Driver Side
Hub Cap Bolt	5/16-18 Grade 5	20-30(1)	
Wheel Nut	M22x1.5 (Hub Piloted)	450-500(2) (Dry Threads)	

1) Torque applied to bolt head
2) Recheck Wheel Nut torque after first 50-100 miles

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